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No. 118

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5 September 1979

# USSR REPORT

## BIOMEDICAL AND BEHAVIORAL SCIENCES

No. 118

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REMOTE SENSING PHENOLOGY IN GEOBOTANY

Leningrad BOTANICHESKIY ZHURNAL in Russian Vol 64, No 6, 1979 pp 805-819

[Article by B. V. Vinogradov, Leningrad Section, Institute of Oceanology, USSR Academy of Sciences, submitted for publication 27 December 1977]

Abstract: Remote sensing phenology is a method for studying the seasonal rhythm of vegetation and ecological conditions by means of a comparison of aerial and space photographs taken at different seasons over one and the same territory under comparable atmospheric and optical survey conditions. The different technology of phenooptical measurements makes it possible to study phenological changes at points, along profiles and over mapped areas. Automatic methods for the detection of changes and comparison of phenooptical maps are of the greatest interest.

[Text] Remote sensing phenology includes study of the seasonal rhythm of vegetation and ecological conditions by means of a comparison of repeated photographs of the earth taken from aircraft and space vehicles. Such repeated surveys of the earth are made over one and the same territories at definite time intervals using different remote sensors -- photographic, spectrometric, multispectral, television, infrared and radiothermal. The advantage of remote sensing phenology is primarily the spatial-temporal integration of phenological observations by means of repeated aerial and space photographs. It ensures obtaining integral characteristics with an adequate frequency and sufficiently great coverage and the detection of complex spatial nonuniformities of the phenological process. The difficulties in interpretation of repeated remote sensing photographs involve primarily a differentiation of the rhythm of development of individual plants, phenological synusia, and individual ecological factors having specific seasonal rhythms.

Remote sensing phenology developed together with the first experiments with the aerial surveying of vegetation (Samoylovich, 1930, 1937). Individual examples of remote sensing phenology have been described in monographs on

remote sensing (Vinogradov, 1966; Tolchel'nikov, 1974; Reeves, 1975). Reviews of the literature and the methodological prerequisites on remote-sensing phenology were published earlier (Colwell, 1968; Vinogradov, 1969, 1977a; Galkina, Meleshko, 1974; Morain, 1974; Rabchevsky, 1977). There have been two opposite approaches to remote sensing phenology: some researchers regard a remote sensing survey as intended for the detection of phenological changes (Vinogradov, 1966); others, on the other hand, use surface phenological observations for planning the times of remote-sensing surveys (Kharin, 1966). The objective of this article is a generalization of world attainments in remote-sensing phenology and determination of the place of this branch in remote-sensing ecology (which, as is well known, can be divided into four parts: remote study of the composition, structure, rhythm and dynamics of ecosystems (Vinogradov, 1977b).

For a phenological study of vegetation use was first made of an aerial photographic survey of forests in different seasons (Samoylovich, 1930, 1937, 1960; Sayn-Wittgenstein, 1961; Girard, 1970; Schram, 1974), plantings of agricultural crops (Brunnschweiler, 1957; Boesch, Brunschweiler, 1960; Steiner, 1961; Vinogradov, 1966; Schepis, 1968), pastures, steppes and deserts (Vinogradov, 1956, 1960). [In this article we do not consider aerovisual methods. Although promising for phenological observations (Samoylovich, 1956), they exclude the objective registry of remote-sensing data.] These studies contain numerous examples of aerial photographs of individual plant communities and their combinations taken at different seasons. These show a complex spatial structure of the phenological process. Specialists have carried out not only visual comparisons of repeated aerial photographs, but also a quantitative analysis of changes in the optical density of images obtained during different seasons (Vinogradov, Yantush, 1957; Steiner, 1961; Afanas'yev, et al., 1975). A repeated aerial photographic survey was the most effective means for studying the fine spatial structure of phenological changes, especially at the population, subphytocenotic and phytocenotic levels with dimensionalities of the elements from the first tens of centimeters to tens of meters.

Multispectral and multizonal surveys carried out during the entire growing season simultaneously in different spectral intervals represented great progress in remote-sensing phenology due to the more precise identification of the composition of plant associations and plantings of agricultural crops. In the optical range the most informative spectral intervals were in the green  $\lambda\lambda = 0.52-0.56$ , red  $\lambda\lambda = 0.62-0.68$  and near-infrared  $\lambda\lambda = 0.8-1.1 \mu m$  spectral zones. [The following notations are used in the article:  $D$  — optical density of negative photographic image,  $dD$  — difference in optical density,  $D_n$  — zonal optical density,  $BRP$  — a parameter of zonal ratios,  $e$  — base of natural logarithms,  $K_\lambda$  is the spectral contrast  $(r_{\lambda_1} - r_{\lambda_2}) / (r_{\lambda_1} + r_{\lambda_2})$ ,  $r_\lambda$  is the spectral brightness coefficient,  $R_n$  is the zonal brightness coefficient,  $m$  is ground green biomass,  $T_K$ ,  $^{\circ}C$  is radiation temperature,  $T_B$ ,  $K$  is radiobrightness temperature,  $t$  is time (months),  $\epsilon$  is emissivity,  $\nu$  is space frequency,  $\lambda$  is the wavelength of the electromagnetic spectrum,  $\varphi^0$  is geographic latitude,  $\lambda\lambda$  is the spectral interval,

$f(D)$  is a function of optical density,  $r$  is the correlation coefficient.] The successive surveys in different spectral zones have been carried out primarily over plantings of agricultural crops (Richardson, et al., 1972; Hay, 1974). They made it possible to determine not only the precise spatial structure, but also the species composition of the agrocoenoses.

In order to obtain more specific remote characteristics of phenological changes in vegetation specialists have been carrying out successive aerial spectrometric surveys of one and the same forested areas, desert pastures and sowings of agricultural crops (Belyayeva, et al., 1966; Rachkulik, Sitnikova, 1967). [This study does not include numerous ground spectrophotometric measurements of the seasonal variation of the spectral brightness coefficient for plants and plant associations (Olson, Good, 1962; Galkins, Meleshko, 1974; Brach, Mack, 1977) which can be used in remote-sensing phenology only after a very complex spatial integration procedure, allowance for the indicatrix of light scattering by the active surface of the vegetation layer and the atmospheric spectral transfer function.] Such surveys are being carried out in the visible  $\lambda\lambda = 0.4-0.7$  and near-infrared  $\lambda\lambda = 0.7-1.4 \mu m$  spectral zones with a spectral resolution  $0.05-0.1 \mu m$  and give specific optical criteria for detecting some phenophases. The principal advantage of successive aerospectrometric measurements is the possibility of a correct physical explanation of the pheno-optical changes in vegetation. However, the difficulties in carrying out such surveys are also evident: beginning with identification of the target area and ranging through standardization of comparable atmospheric-optical conditions.

A repeated survey in the middle infrared zone of the spectrum in the atmospheric transparency windows  $\lambda\lambda = 3.4-5.6$  and  $8-14 \mu m$  is of great interest for study of the seasonal rhythm of vegetation, habitat conditions and their radiation regimes (Myers, Heilman, 1969; Ellis, Vonder Haar, 1976). One of the specific characteristics of remote phenological measurements of the radiation regime in the middle infrared zone of the spectrum is the complex mechanism of formation of a remote signal, together with the influence of vegetation integrating the effect of other components of the geosystem: emission of the soil and absorption of radiation by the atmosphere. Second, diurnal changes in the intensity of incoming solar radiation and meteorological variations of atmospheric transparency are so great and rapid that great difficulties are created in comparison of remote measurements in this spectral zone even after very short time intervals.

Daily television surveys from meteorological artificial earth satellites give the overall phenological characteristics of vegetation, agricultural crops and ecological conditions (Conover, 1965; Sabatini, et al., 1971; Martin, 1973; Vinogradov, 1976). The spatial resolution of the television photographs is  $0.3-3 km$ , but the great frequency of the survey (daily or once every several days) and the obtaining of accompanying hydrometeorological data (on snow cover, cloud cover, moistening) make them very useful for phenological observations.

Multispectral successive photographs taken from satellites for the study of natural resources of the "Landsat" type and some "Meteor" artificial earth satellites are most promising for remote-sensing phenology. Most frequently there was a comparison of photographs taken from the "Landsat" artificial earth satellite at intervals of 18 days or more with a spatial resolution of 1 hectare and a photo coverage of 250,000 square kilometers. Such observations of the seasonal development of vegetation were carried out over different regions of the United States, Canada, France and other countries (Dethier, et al., 1973; Ashley, et al., 1973; Kirby, 1974; Ashley, Rea, 1975; Turner, 1976; Bentley, 1976). They made it possible to obtain the most correct integral phenoptical characteristics of different vegetation formations at the regional and zonal levels.

The essence of formation of the seasonal variation of changes in a remote image is determined by the dependence of the optical and radiation remote measurements of the spectral brightness coefficient  $r_\lambda$ , optical density of the negative  $D$ , emissivity  $\epsilon$ , radiation temperature  $T_R$ , °C on the seasonal changes in the phytocenometric characteristics of surface green biomass  $m$ , leaf index  $L$ , projective coverage  $P$ , moisture content of tissues  $w$ , relative area of dry bleached leaves and fallen-off leaves  $S_d$ . The dependence of the optical characteristics on green surface biomass is most indicative. In the visible (photographic) spectral zone  $\lambda\lambda = 0.5-0.7\mu m$ , with an increase in  $m$  of the green vegetating plants its  $r_\lambda$  and  $D$  usually decrease, but nonlinearly. The dependence  $r_\lambda(m)$  is described by a power function of the type

$$r_\lambda = ae^{-bm} + c,$$

where  $a, b, c > 0$  (Vinogradov, 1976, p 225). Characteristically there is a negative value of the power  $e$  in the red zone of the spectrum with  $\lambda\lambda = 0.62-0.68\mu m$  and positive in the near infrared  $\lambda\lambda = 0.8-1.3\mu m$ .

Depending on the form of representation of remote-sensing data in phenology, it is possible to examine three types of analysis of phenoptical characteristics: point, profile and spatial.

#### Phenoptical Measurements

Point phenoptical measurements include a time series of reflective or emissive characteristics of one and the same sector of the vegetation cover during different seasons obtained from aircraft and satellites. Point photometric measurements of the optical density of repeated aerial photographs gave the first quantitative remote-sensing data on phenological changes in vegetation (Steiner, 1961, 1970). Depending on the composition of the phytorythm types (according to I. N. Beydeman) of vegetation associations, the rhythm of hydrometeorological conditions and the seasonality of man's economic activity during the course of the growing season there are different curves of the seasonal variation of changes in the optical density of the photographic image of vegetation associations: smooth and sharp, single- and multi-peaked, symmetric and asymmetric and complex.

In desert associations with psammophilic scrub and ephemeral grassy vegetation (ass. *Haloxylon persicum* + *Carex physodes*) there is a well-expressed growing phase of the synusia *Carex physodes*. Its image gives a minimum of optical density of the negative photographic image in the seasonal phenooptical picture. The phase has a small extent (averaging 55 days), but gives a strong temporal optical gradient (a change by 0.5-0.7 unit of negative density per week). This is a sharp asymmetric single-peaked phenooptical curve (Fig. 1,A).

A considerably more complex seasonal variation of the optical density of the photographic image is observed in associations where the edificators of synusia belong to different phytorhythm types. For example, in desert-steppe associations with edificators of soddy euryxerophilic grasses (*Stipa lessingiana* + *Festuca rupicola*) and haloxerophilic subshrubs (*Seriphidium lercheanum* + *Kochia prostrata*) in the seasonal variation there are two maxima of the increment of surface biomass, and accordingly, two minima of optical image density. During the growing season for grasses (late May-early June) there is a first, early summer and deeper  $\min_1$  of optical density, whereas during the growing season for subshrubs there is a late summer and less deep  $\min_2$ . As a result such polycomponent associations, consisting of different phytorhythm types, give a quite distinct multi-peaked (in this case two-peaked) phenooptical curve (Fig. 1,B).

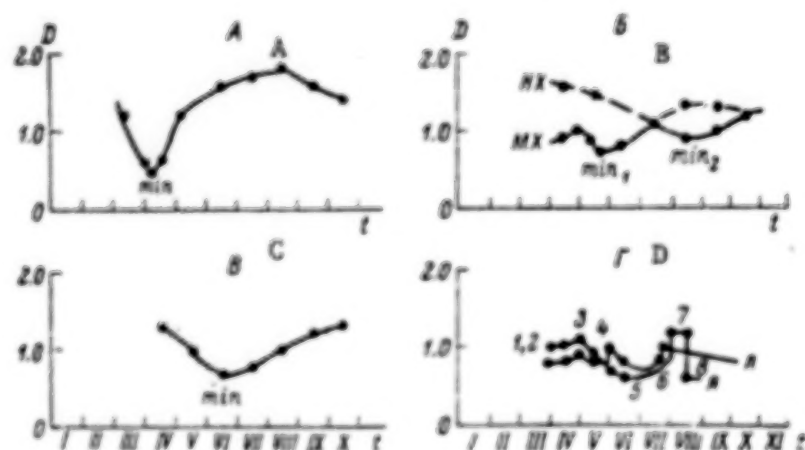


Fig. 1. Seasonal variation of changes in point photometric characteristics of optical density D of aerial photographs taken in different seasons. A) ass. *Haloxylon persicum* + *Calligonum setosum*-*Carex physodes* (orig.); B-MX) fragments of ass. *Stipa lessingiana* + *Festuca rupicola*; HX) fragments of ass. *Seriphidium lercheanum* + *Kochia prostrata* (orig.); B) ass. *Haloxylon persicum*-*Kochia prostrata* + *Seriphidium terrae-albae*-*Elytrigia gracile* (Vinogradov, 1976); D) barley fields (■) and mown meadow (□); 1-8) phenophases of sown crops (Steiner, 1961); t) time (months).

A successive comparison of photographic images of woody-scrubby associations gives the smoothest shape of the phenooptical curve (Fig. 1, C) with a decrease in optical density at the beginning of the growing season, a minimum density during the period of maximum green biomass and an increase in density with the yellowing and falling off of the plant sprouts. Such a shape is observed, for example, in the northern deserts in the association *Haloxyton persicum* + *Kochia prostrata* + *Seriphidium terrae-albae* + *Elytrigia gracile*, where a decrease in image density is observed in March, low densities — in June-July and an autumn increase — in August-September.

The most complex variation of the phenophases and alternation of agrotechnical procedures is characteristic of agrocoenoses and other associations subjected to man's economic activity. They are characterized by seasonal curves of optical image density with sharp phenooptical shifts not encountered under natural conditions. In the alternation of phases of sown areas of spring crops there is the following seasonal variation of image density (Fig. 1, D,  $\Phi$ ). During the spring drying out of soils with the onset of soil "ripeness" with an increase in their  $r_\lambda$  there is a rapid increase in optical density of the negative image (1 in Fig. 1, D,  $\Phi$ ). Spring plowing and sowing give a sharp but brief density decrease (2), after which a moderately high density level is again restored (3). With the appearance of sprouts and growth of surface biomass their  $r_\lambda$  decreases, the image density is gradually reduced (4) and attains a minimum in the earing stage, which corresponds to the period of maximum green biomass (5). Then, in the stage of milky-golden and golden maturity, in connection with the drying out of plants, their  $r_\lambda$  increases, whereas the density somewhat increases (6). After harvesting the image density in a short time is sharply increased (7), and then after plowing of the stubble in autumn there is a sharp decrease (8). The seasonal variation of optical image density of a sown meadow also gives marked periodic sawtoothlike density increases after each hay mowing and aftergrowing (Fig. 1, D,  $\Phi$ ).

Specific information on the phenology of vegetation associations can be obtained by a comparison of curves of the spectral brightness coefficients  $r_\lambda$  for different seasons over one and the same areas under comparable illumination conditions. For example, it is known that at the beginning of the growing season young leaves are characterized by higher  $r_\lambda$  with a maximum 0.14-0.18 in the green part of the spectrum at  $\lambda\lambda = 0.52-0.56\mu\text{m}$ . In the stage of a mature leaf  $r_\lambda$  is reduced to 0.12-0.16, and in the red part —  $\lambda\lambda = 0.62-0.68\mu\text{m}$  — to 0.05-0.07. Finally, with yellowing of the leaves the spectral selectivity of the curve  $r_\lambda$  disappears, its variation in the visible spectral zone is increased, whereas it decreases in the near-IR. Against this background there are some peculiarities of phenological changes  $r_\lambda$  associated with flowering, fruit bearing, agricultural use and weather conditions.

In order to obtain the phenooptical characteristics, however, it is more desirable to compare not the curves, but discrete measurements of  $r_\lambda$  in narrow spectral ranges, since the  $r_\lambda$  curves in general give excess information

and can be reconstructed on the basis of optimally selected zonal  $r_\lambda$ . It is assumed that in the optical range in order to reconstruct the  $r_\lambda$  curve it is sufficient to make discrete measurements of  $r_\lambda$  at  $\lambda = 0.44-0.48 \mu\text{m}$  ( $R_1$ ),  $0.52-0.56$  ( $R_2$ ),  $0.62-0.68$  ( $R_3$ ) and  $0.82-0.88$  ( $R_4$ ). The differences between  $R_3$  and  $R_4$  are most indicative in this respect. Such a seasonal variation of  $r_\lambda(t)$  in the IR range  $R_4$  in cotton fields, measured from an aircraft (Belyayeva, et al., 1966), has a well-expressed rise in the course of the growing season with an increase in the projective cover of plants and an increase in the green surface biomass. At the same time, in the red zone  $R_3$  there is a decrease in  $r_\lambda$  with an increase in biomass. At the end of the growing season the seasonal variation of  $r_\lambda(t)$  is represented by a curve of the opposite shape, which is associated with the drying out of plants. The seasonal variation of spectral contrast  $K_\lambda$  in the near-IR  $R_4$  and red  $R_3$  spectral zones

still more intensifies the seasonal optical gradients (Fig. 2,A). The minimum values  $K_\lambda = 0.3-0.4$  fall at the beginning and end of the growing season, whereas the maximum values  $K_\lambda = 0.8-0.9$  fall in the period with the maximum green biomass of this agrocoenosis. Naturally, in different types of vegetation the seasonal variation  $K_\lambda(t)$  changes. As a result, a multi-zonal survey taken at different seasons can be used in constructing a phenooptical "calendar" which shows the phenological changes in the optical characteristics of different phyto- and agrocoenoses. Such a "calendar" of development of sown areas of agricultural crops was of the greatest interest (Pettinger, 1969).

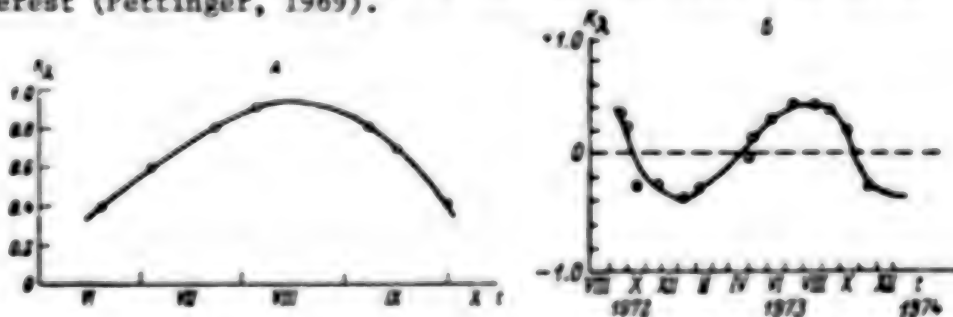


Fig. 2. Seasonal variation of changes in spectral contrast. A)  $K_\lambda$  of sown cotton fields between red  $\lambda\lambda = 0.62-0.68$  and near-IR  $\lambda\lambda = 0.82-0.86 \mu\text{m}$  spectral zones (Belyayeva, et al., 1966); B)  $K_\lambda$  of broadleaf forest between zones  $\lambda\lambda = 0.6-0.7$  and  $0.8-1.1 \mu\text{m}$  (Ashley, et al., 1973).

Point phenooptical characteristics were obtained using multispectral photographs from the "Landsat" artificial earth satellite by means of measuring the optical density of partial images in two spectral zones — in the red — MSP-5 [MSP = multispectral photograph] at  $\lambda\lambda = 0.6-0.7 \mu\text{m}$  (D5) and in the near-IR — MSP-7 at  $\lambda\lambda = 0.8-1.1 \mu\text{m}$  (D7). On the basis of these measurements in two spectral zones researchers (Dethier, et al., 1973; Ashley, et al., 1973) have computed the band ratio parameter:

$$BRP = (D_1 - D_2) / (D_1 + D_2).$$

The authors feel that an advantage of this coefficient is that it takes into account not only the differences in the spectral brightness coefficients of vegetation in different phases of phenological development, but also corrects different illumination during the time of a survey. The density of the negative image  $D_2$  of green growing vegetation decreases in the course of the growing season and increases with its end, with the yellowing and falling off of assimilation shoots. The seasonal variation of density  $D_1$  has the opposite behavior. As a result, the BRP coefficient increases with an increase in projection of the green growing vegetation and decreases with its decrease. In an analysis of successive multispectral images from the "Landsat" artificial earth satellite of a key sector of hardwood forest in the state of Vermont it was demonstrated that the BRP increases with the development of the leaves and decreases with yellowing and falling off of the leaves (Fig. 2, B).  $BRP = 0.25-0.50$  is observed when there is complete leafing,  $0.10-0.25$  — in transitional phenophases of leaf development and autumn coloring, below  $0.10$  — after complete falling of the leaves.

In addition to point photometric measurements of mean density, there are interesting seasonal changes in some image statistics. There are seasonal changes in the amplitude of density, the frequency of density fluctuations and the statistical distributions of these parameters (Dethier, et al., 1972; Afanas'yev, et al., 1975). For example, in the course of the phenological development of the meadow association *Anthoxanthum odoratum* + *Agrostis tenuis*: *Trifolium repens* there are the following changes in the frequency-spatial characteristics of the image  $\nu_D$ .

In spring at the beginning of the growing season there is a predominance of low frequencies of image texture  $\nu = 0.1 \text{ m}^{-1}$ , reflecting primarily the spottiness of the soil cover (Fig. 3, 1). In summer in the course of the growing season for grasses, legumes and mixed grasses the frequency range of the image is considerably broadened into the high-frequency region with  $\nu = 0.1-0.3 \text{ m}^{-1}$ , which reflects both the spottiness of the ecological conditions and the population structure of the phytocoenosis (Fig. 3, 2). At the end of summer, due to the growth of late-growing large grasses, the frequency maximum is displaced still more in the direction of the high frequencies  $\nu = 0.5 \text{ m}^{-1}$ , whereas the low-frequency component is masked by twigs and fallen leaves (Fig. 3, 3).

It is of great interest for ecological investigations to have seasonal measurements of the radiation  $T_g$  and radiobrightness  $T_b$  temperatures of vegetation and the underlying surface, measured in the windows of atmospheric transparency ( $\lambda\lambda = 3.5-5.6, 8-12 \mu\text{m}, 0.8-1.5, 3.5$  or more  $\text{cm}$ ), both from aircraft and from artificial earth satellites. These emissivity characteristics are subject to strong spatial-temporal variability. Nevertheless it has been demonstrated (Myers, Heilman, 1969; Vinogradov, 1976) that in

the course of the growing season as a rule with an increase of above-ground biomass of vegetation  $T_R$  decreases (Fig. 4,A), whereas  $T_B$  increases (Fig. 4, B). These peculiarities form the spatial nonuniformities of the  $T_R$  and  $T_B$  fields against a background of a monotonic seasonal variation of the mean  $T_R$  and  $T_B$  values, which duplicates the annual variation of the mean soil surface temperature (Nixon, et al., 1973; Kunzi, et al., 1974; Ellis, Vonder Haar, 1976).

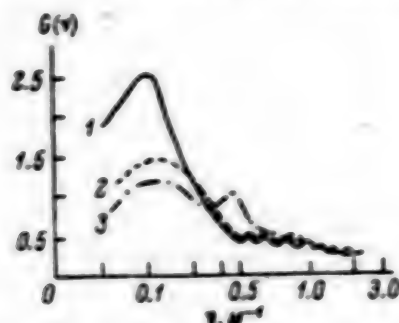


Fig. 3. Seasonal changes in spectral density  $G(v)$  of space frequency of aerial photographic images of meadow obtained during different seasons. 1) spring 27 April; 2) summer, 8 July; 3) at end of summer, 10 August (Afanas'yev, et al., 1975).

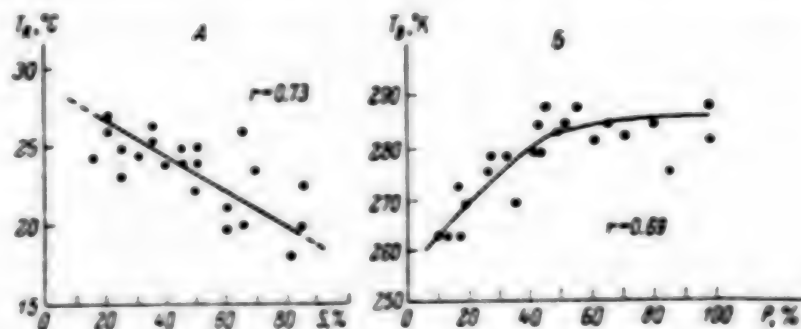


Fig. 4. Form of dependence of some emissivity characteristics of earth's surface measured from aircraft and "Cosmos-243" artificial earth satellite on instantaneous phytocenometric parameters of vegetation cover. A) radiation temperatures  $T_R$ , °C in range  $\lambda\lambda = 8-14 \mu\text{m}$  at 1900 LT on 1 June from height of 600 m on a projective cover of cotton S, % (Myers, Heilman, 1969); B) radiobrightness temperatures  $T_B$ , °K in range  $\lambda = 3.4 \text{ cm}$  on 24 September in morning from height of 300 km on relative forest cover S, % (orig.); r is the correlation coefficient.

### Pheno-optical Profiles

The second branch of remote-sensing phenology includes the construction of different kinds of pheno-optical profiles by means of a comparison of repeated aerial and space photographs. A comparison is made of both local pheno-optical profiles reflecting spatial phenological nonuniformities within the limits of individual landscapes and land-use areas and zonal and regional phenological nonuniformities corresponding to seasonal circulation-climatic changes.

Local phenological structures were detected by means of a comparison of microphotometric profiles run across repeated aerial photographs along identical paths with an extent on the ground from tens of meters to several kilometers (Vinogradov, Yantush, 1957; Vinogradov, 1966). The compared (in pairs) microphotometric profiles of images obtained in different seasons are characterized by different frequency, amplitude and sign of variation. In general form it is possible to discriminate pairs with inverse, incipient, changing and mixed shape of the traces (Fig. 5).

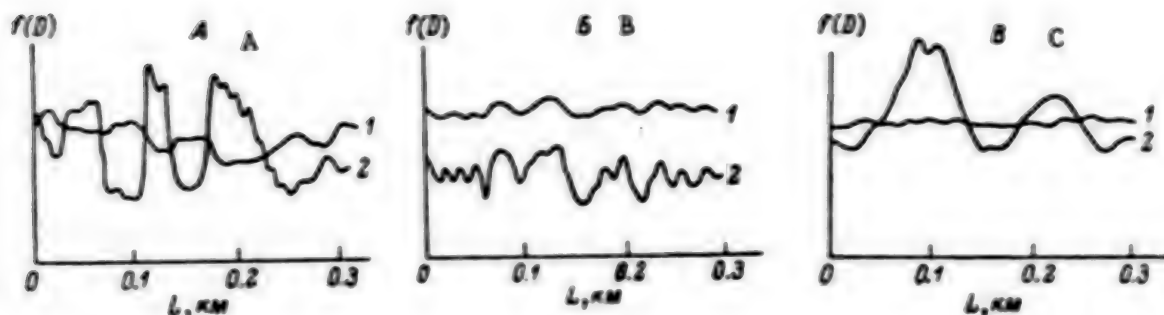


Fig. 5. Principal forms of comparisons of microphotometric profiles of aerial photographs of different vegetation associations, obtained in different seasons, with different shape of traces. A) inverse (1 -- summer aerial photographic survey, 2 -- autumn survey); B) starting (1 -- early summer, 2) summer); C) changing (1 -- summer, 2 -- late summer) (Vinogradov, 1966)

As indicated in Fig. 5,A, the first pair of microphotometric traces obtained at different times intersects a combination of saline soils deprived of higher vegetation and sectors of the association *Puccinellia dolicholepis* + *Herbae halomesophyticae* with a coverage of 60-80% (Fig. 5,A). On a negative of a summer aerial photograph dry saline soils give the highest optical densities  $D$ , whereas sectors of growing vegetation give the lowest optical densities (Fig. 5,A,1); in autumn, on the other hand, moist soils give the lowest  $D$ , whereas sectors of dessicated meadow-solonchak vegetation give the highest  $D$  (Fig. 5,A,2). The second pair of traces shown in Fig. 5,B intersects an image of a complex of fragments of the association *Stipa lessingiana* + *Festuca rupicola* and the association *Seriphidium pauciflorum* + *Kochia prostrata*. There is a considerable intensification of the amplitudes of the traces in the case of a survey during the moist period (Fig. 5,B,2) in comparison with an arid period (Fig. 5,B,1). Finally, the third pair of traces in Fig. 5,C characterizes the appearance of images of spatial nonuniformities in an area sown in wheat during the time of its golden maturity at the beginning of August (Fig. 5,C,2), there where during the time of tillering and

earing in July there were no spatial differences conspicuous (Fig. 5,C,1).

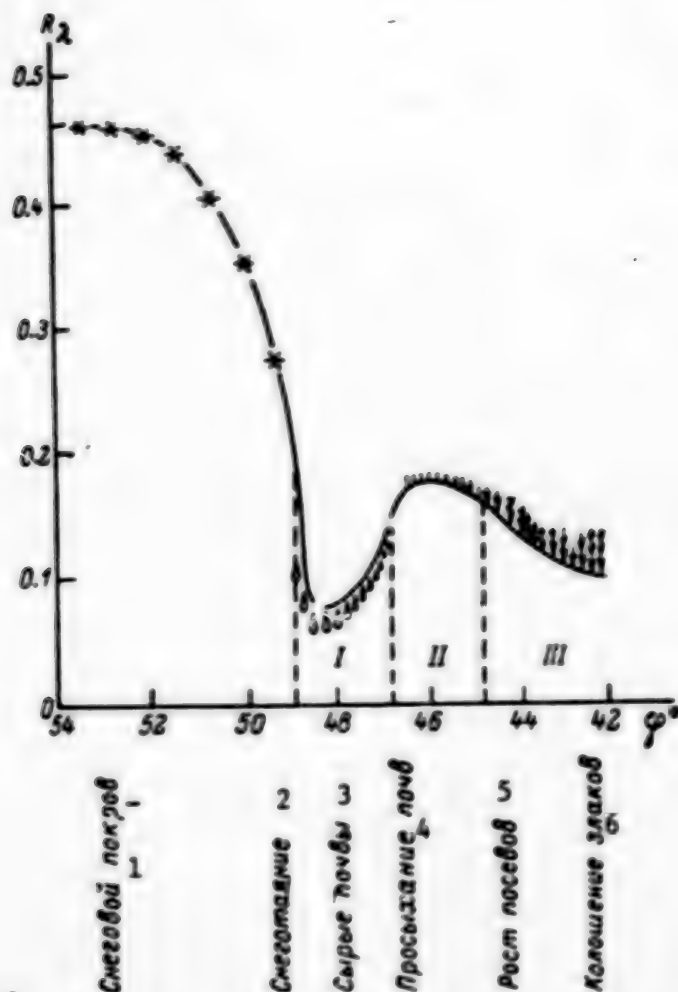


Fig. 6. Meridional phenooptical profile in southern European USSR, constructed on the basis of a TV image from the "Meteor-1" artificial earth satellite on 14 March 1972 along longitude 40°. I) "dark wave" ( $r_\lambda$  less than 0.12) — snow melting and early spring overmoistening of soils; II) "gray wave" ( $r_\lambda$  more than 0.15) — spring dessication of soils; III) "green wave" ( $r_\lambda$  in red zone less than 0.15,  $r_\lambda$  in IR zone greater than 0.4) — growing season (orig.).

KEY:

- |                 |                             |
|-----------------|-----------------------------|
| 1. Snow cover   | 4. Dessication of soils     |
| 2. Snow melting | 5. Growth of shoots         |
| 3. Moist soils  | 6. Ear formation of cereals |

Zonal and regional phenooptical profiles can also be prepared using simultaneous photographs oriented across the strike of climatic zonality and zonality by elevation. They form zonal or regional bands (called "corridors" in studies by American authors) with an extent of several thousand kilometers. The first such phenological profiles were run along aerovisual routes (Samoylovich, 1937). Space photographs show the passage of a number of integral phenological phases (called "waves" in the studies of American authors) from south to north. As an example we cite a phenooptical meridional profile reflecting the spring passage of phenological waves in the territory of the southern part of the Russian plain, constructed on the basis of a television photograph from the "Meteor-1" artificial earth satellite taken on 14 March 1972. The first "dark wave" reflects a marked decrease in the brightness coefficient during snow melting and early spring overmoistening of the soils (Fig. 6, I). With dessication of the soil and its attainment of presowing ripeness the brightness is somewhat increased and a second, "gray wave" is noted (Fig. 6, II). Then, with the appearance of sprouts and the development of leaves there is a change in the spectral brightness coefficient and a "green wave" is formed (Fig. 6, III).

Zonal and regional phenological profiles obtained using repeated photographs from the "Landsat" artificial earth satellite taken at intervals of 18 days were investigated along three meridional and one regional "corridor" in the United States (Dethier, et al., 1973; De Gloria, et al., 1975). The Appalachian corridor intersected zones of broadleaf, mixed and southern "taiga" forests, the Mississippi corridor extended from the semidesert to mixed forests, the Rocky Mountain corridor extended from the subtropical deserts to the boreal steppes, and finally, the Columbian corridor revealed a zonality by elevation from the foot to the peaks of the mountains. The passage of two integral phenological phases, "green" and "brown" waves, were of the greatest interest. The "green wave," visible on space photographs, reflects the spring-early summer development of leaves of trees and bushes and the sprouting of grasses. A "brown wave" also is traced from south to north and is associated with fruit formation and the yellowing of grasses, autumn coloring and falling of leaves from trees and bushes. Investigations have shown that phenological changes do not always move longitudinally, but instead have considerable regional and local deviations. A result of analysis of a system of meridional phenological routes should be the formulation of an empirical and computed (with hydrometeorological measurements taken into account) model for spatial extrapolation, compilation of a world phenological map and a stochastic prediction of the phenological development of vegetation.

### Phenooptical Mapping

The third and most important branch of remote-sensing phenology is phenological mapping, that is, the preparation of a multidimensional (latitude, longitude, time) model of the phenological process. A visual comparison of dichronous (that is, obtained at two times) aerial photographs was used long ago for a spatial representation of some phenological phenomena. Such

comparisons made it possible to prepare large-scale dichronous phenological maps, for example, of the spring development of ephemeroïds (primarily *Carex physodes*) in the Chil'mamedkum desert at a scale 1:5,000 (Vinogradov, 1962) using aerial photographs taken in April (Fig. 7,A) and in August (Fig. 7,B). On a spring photograph in the association *Haloxylon persicum* + *Calligonum setosum* - *Carex physodes*:*Anisantha tectorum*:*Plantae annuae* the greater the coverage of the grass level, the darker will be the tone of individual fragments of the lower level. The darkest tone is from fragments with a cover of *Carex physodes* greater than 25% (Fig. 7,C,1), transitional dark gray with a cover of 10-25% (Fig. 7,C,2) and gray with a cover of 5-10% (Fig. 7,C,3). Finally, bright and light gray tones, varying least on photographs taken during different seasons (Fig. 7,A,B), are given by fragments with a grass cover of less than 5% (Fig. 7,C,4,5).

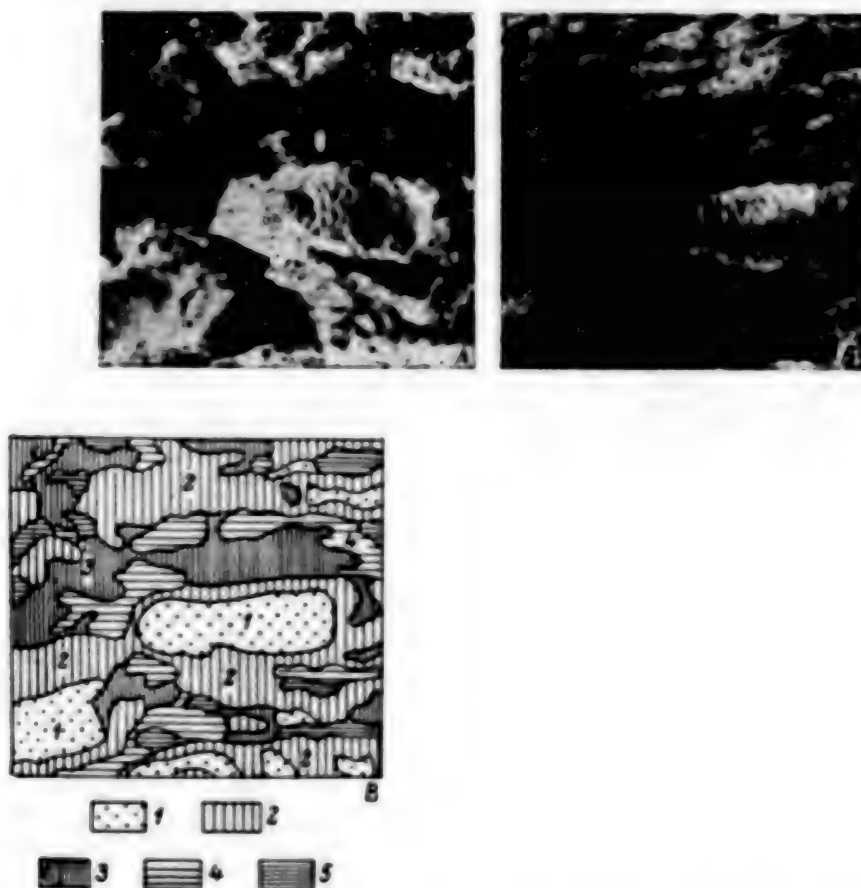


Fig. 7. Comparison of aerial photographs taken at different seasons on panchromatic-10 film showing sands of southern deserts with association *Haloxylon persicum* + *Calligonum setosum* - *Carex physodes*:*Anisantha tectorum*:*Plantae annuae*. A) spring aspect (April); B) late summer aspect (August) for preparation of dichronous phenological map at a scale 1:5,000; C) explained in text (Vinogradov, 1962).

The photomechanical method for detecting seasonal changes is based on a simple comparison of rectified aerospace images: "flicking" (rapid switching of the projection between two images at a rate of 10 frames/sec), "sandwich" (superposing a positive image of one survey date on a negative of another). A photometric method for preparing phenological maps which is based on the discrete measurement of the optical characteristics of one and the same territory at definite time intervals is more correct. Successive photographs are rectified in rectangular coordinates at one and the same scale and are standardized with respect to optical density and illumination. Then the optical densities of identical points on these rectified images are subtracted. The resulting differences or some other differentiating functions of the optical characteristics indicate definite phenological shifts. This is followed by the stage of interpretation of optical differences in dependence on the changes in the phases of development of vegetation and changes in ecological conditions. At the output such dichronous phenooptical comparisons can be represented in the form of a conventional color image, a map with symbols and digits (display) (Borden, Applegate, 1973; Carneggie, De Gloria, 1973; Rey, 1974; Kristoff, Baumgardner, 1975; De Gloria, et al., 1975; Turner, 1976; Bentley, 1976; Vinogradov, 1977b). In principle it is also possible to prepare polychronous (that is, using many dates) phenooptical maps, but the representation of data in this case is more complex: there is successive processing of mutually comparable images (Lillistrand, 1972). Some diurnal and weather changes of images, primarily changes in shadows in dependence on solar altitude and azimuth, can be automatically determined from an analysis.

As an example of a metric analysis of dichronous photographs we cite a comparison of spring (early April, Fig. 8,A — see insert) and summer (August, Fig. 8,B) aerial photographs at a scale 1:5,000 of solonchak, meadow-solonchak and sandy sectors of the desert of Western Turkmenia with respect to the levels of optical density of the negative image (Fig. 8,C,D).

Here on the digital image obtained in spring the lowest negative densities  $D = 0.4-0.6$  are given by crusty-moist solonchaks, sometimes covered with a water layer (Fig. 8,C-1). Higher densities  $D = 0.7-0.8$  are characteristic of the association of summer-vegetating perennials *Alhagi persarum*, *Aeluropus litoralis* on meadow-solonchak soils (Fig. 8,B-2). Intermediate density levels  $D = 0.9-1.2$  are given by aggregations of *Halocnemum strobilaceum* on puffy solonchaks with a fresh soil surface and also sands with a cover of ephemeral plants and ephemerooids up to 10-25% (Fig. 8,C-3,4). During this period poorly consolidated sands with a cover of less than 5% and the aggregation *Halocnemum strobilaceum* on solonchaks with a dry salt crust on the surface are characterized by high densities  $D = 1.3-1.4$ .

On late summer aerial photographs the lowest densities are characteristic of the association *Alhagi persarum* + *Aeluropus litoralis* + *Cynodon dactylon*, *Bolboschoenus maritimus*, *Scirpus tabernaemontani*, by this time attaining the maximum vegetative development with respect to surface green biomass (Fig. 8, D-1). Sectors of the association *Alhagi persarum* + *Aeluropus litoralis* + *Halocnemum strobilaceum* with a lower cover (to 60%) virtually did not change



the image density, since the decrease in reflectivity due to the increment of surface biomass was compensated by a decrease due to decrease in soil moisture content (Fig. 8, D-2). However, sectors with a cover up to 40% became lighter (Fig. 8, D-3). An aggregation of *Halocnemum strobilaceum* with a cover up to 40% on puffy solonchaks acquired an average image density (Fig. 8, D-4), and with a cover up to 20% — above average (Fig. 8, D-5). The same quite high image densities are given by sands (Fig. 8, D-5). During this season the highest densities are characteristic of dry crusty solonchaks (Fig. 8, D-6).

Digital maps of the differences in optical densities (dD) on spring and summer photographs (C minus D) give the following results (Fig. 8, E, F). Positive dD correspond to an increase in surface green biomass of summer-vegetating vegetation; the greater the dD value, the greater is the increment of biomass. Negative dD indicate a summer decrease in soil moisture content, crystallization of salts on the surface of solonchaks and dessication of ephemeral and ephemeroïdal vegetation on sands. The maximum negative dD are observed on crusty solonchaks.

In conclusion the following additional comments must be made. A description of remote-sensing phenology would be incomplete without two auxiliary aspects: use of photographs taken at different times for increasing the accuracy in identifying the composition of vegetation and allowance for surface phenological observations for a priori determination of the optimum times for a remote survey.

The first auxiliary direction includes a comparison of photographs of one and the same vegetation associations, taken at different times, reflecting the phases of development of different time synusia, and gives a considerable increase in the detail and accuracy of interpretation of remote images. The simultaneous use of early and late summer photographs of dry steppes and semideserts, for example, will make it possible to identify with a probability of 0.9 both mesoxerophilic grasses and haloxerophilic subshrubs, whereas one of these surveys gives only partial information about the association (Vinogradov, 1966). Such a multiple survey has been recommended for the interpretation of many vegetation associations consisting of synusia of different phytorhythm types, for example, psammophilic shrubs and grassy ephemeroïds — in spring and late summer, conifer and deciduous trees — in summer and autumn, etc. In the desert irrigated agricultural landscapes in the state of Arizona a comparison of May and July photographs increases the identification accuracy from 60-75 to 90-99% (Richardson, et al., 1972; Hay, 1974). As a result, a singular phenological calendar was proposed for a survey of fields of agricultural crops (Dethier, et al., 1973). Surveys of forests and agricultural lands in the southern "taiga" landscapes in New Brunswick Province, made in different seasons, in May, June and October (Moore, Gregory, 1974) and in Ontario Province in June, September and October (Kalensky, 1974) gave an increase in identification accuracy from 70±10% on the basis of individual photographs to 85±5% on the basis of

photographs taken in different seasons. Thus, the effectiveness of surveys at different seasons for increasing the reliability and practicality of interpretation is not less than and is frequently greater than from the use of multispectral survey systems.

A second auxiliary direction in remote-sensing phenology is the use of surface phenological observations for determining the optimum times of aerial and space surveys, their duration and frequency within the limits of one growing season, and also a priori possible variations during different years, proceeding on the basis of known data on the phenology and optical properties of the vegetation cover. Examples of such a remote-sensing phenological analysis are the recommendations for the optimum times for aerial photographic surveys in the forests of Canada (Sayn-Wittgenstein, 1961) and the USSR (Belov, 1958, 1960; Kharin, 1963, 1966), deserts and steppes in Central Asia and Kazakhstan (Vinogradov, 1956, 1960; Kharin, 1969). In some cases the phenointicators of the optimum times for a remote-sensing survey coincided with the dates of the maximum values of the green surface biomass of edificators and subedificators of vegetation in the dry steppes of Northern Kazakhstan, where the maximum green biomass of euxerophilic soddy grasses fell early in June. In other cases the optimum times of a survey fall on dates with the maximum time gradients of any factor (increment of biomass, soil moisture content). Such, for example, are the landscapes of the clayey deserts of Turkmenistan, where the maximum time gradients (above 10% soil moisture content per month) coincide with the optimum survey time and fall at the end of April and early May.

On the basis of long-term phenological observations of phenointicators of the optimum survey times it is possible to determine both the statistical mean dates and their probable deviations from year to year. For example, a phenointicator of the time for onset of an aerial photographic survey in the sands of the southern deserts of Central Asia is the flowering phase of *Carex physodes*. The average dates for the mass flowering of *C. physodes* fall on 10 March, whereas the mean deviation from year to year with a probability of 0.9 is  $\pm 10.5$  days. A phenointicator of the end of the optimum time for an aerial photographic survey of sands with different degrees of consolidation is the mass dessication of *C. physodes*, whose average times fall on 5 May, and the deviation is  $\pm 15$  days (Vinogradov, 1969).

In conclusion it should be noted that repeated aerial and space surveys can be used for both an overall or a detailed phenological mapping and detection of anomalies in spatial and temporal phenological changes, especially such changes as the beginning and end of the growing season for pasture vegetation, maturing of fields of agricultural crops, leafing out and falling of leaves in hardwood forests, development of phytoplankton in water bodies, etc. A multistep procedure was proposed for creating an automated remote-sensing system for monitoring the environment; it takes into account the geographic, biological and technical parameters of an operational spatial-temporal model (Steiner, 1970). The first step was the climatic regionalization of the territory, geobotanical regionalization, and classification

by land use types. Then comes the second step — localization of the territory by relief, geological structure and local combinations of vegetation associations. The third step is the specification of remote-sensing detectors with different spectral response. The fourth step is determination of the frequency of the survey from once or twice a week during rapid changes to once or twice a month during periods of rest. Finally, the fifth step is the identification of the composition of vegetation and phenophases. To this must be added a sixth operation — prediction, since the correlation of observed phenophases with hydrometeorological parameters makes it possible to predict, with a definite probability, the development of vegetation for several months in advance (Reeves, 1975).

In the future development of remote-sensing phenology there will be an increase in the accuracy of identification of the composition of vegetation and phenological phases. But even the quite approximate evaluations of the growing season phases which can be made using modern remote-sensing phenology, but made over great areas synchronously and with a great frequency, can constitute part of spatial ecological information systems (naturally, supplementing a surface contact system) of phenological observations, especially at the global and regional levels. Such a remote-sensing ecological information system must include both the relaying of phenological observations of ground stations to processing points, and also the collection and analysis of remote sensing data in the spaces between them.

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ECOLOGY OF NEW FOCUSES OF TRANSMISSIBLE VIRUS INFECTIONS ALONG THE COURSE OF THE OB-AMUR DARYA CANAL

Alma-Ata ZDRAVOOKHRANYENIYE KAZAKHSTANA in Russian No 6, 1979 pp 27-30

[Article by S. K. Karimov, N. I. Drobishchenko and S. G. Rogovaya, Kazakh Scientific Research Institute of Epidemiology, Microbiology and Infectious Diseases]

[Text] Problems of ascertaining and predicting natural focuses of particularly dangerous virus infections becomes especially urgent in connection with the problem of the carry-over of part of the drainage of northern and Siberian rivers into Kazakhstan and Central Asia. The territory of Kazakhstan, with an area of 2.7 million square kilometers, is distinguished by a great variety of landscape-climatic conditions, and is represented by the following systems of natural zones, through which the course of the future canal will pass—forest-steppe, steppe, semi-desert and desert.

The fauna and flora of these zones are rich and unique. For example, in the forest-steppe and steppe zones, along with small birch groves with an area of up to 50 hectares, bushes are growing. The grassy covering is made up of cereals and mixed grass. The fauna of the forest-steppes and steppes is represented by an assemblage of birds and beasts. The mammals are numerous (common and pygmy shrews, northern redbacked vole, forest and field mice, marmots, gophers, jerboas, blue hares, foxes, ermines, wolves, etc.). Muskrats have settled in the ponds. Of the 152 species of mammals in Kazakhstan, 52 are related to the northern forests (A. V. Afanas'yev). Muridae--feeding on preimaginal forms of black-legged ticks--are greatest in number.

The birds are varied (willow grouse and common partridges, rooks, ravens, magpies, jackdaws, sparrows, woodpeckers, cuckoos, red-legged falcons, owls, quail, larks, corncrakes, etc.). The waters are inhabited by flocks of geese, ducks, swans, seagulls, terns, snipe, loons, etc. (I.A. Dolgushin). Reptiles are represented by several species of lizards and snakes.

A substantial part of the canal will also pass through semi-desert and desert zones. The vegetation there is represented by cereal grasses, wormwood and saltworts, and the animal kingdom--by members of both steppe and desert fauna. The steppe lemming, little gopher, large-toothed gopher, great jerboa, thick-tailed three-toed jerboa, Cape hare and others are numerous here. Herds of Saiga antelopes are often encountered. There are many reptiles--lizards, snakes and tortoises. Typical birds are small larks and skylarks, wheatears, steppe eagles, hawks, saksaul sparrows, etc.

The number of species that are vectors of various infectious human diseases is also great. According to the data from the literature, Kazakhstan has over 30 species of hard ticks and soft ticks (I. G. Galuzo et al.), and 50 species of blood-sucking mosquitoes (A. M. Dubitskiy), any of which is a potential arbovirus vector.

The variety of landscape-climatic conditions and of the fauna and blood-sucking arthropods on the proposed route of the canal create the ecological prerequisites for circulation of arboviruses of various antigen groups. According to the official data, in the regions of the future route, there were reports of individual cases of disease through Russian tick-borne encephalitis (Kustanayskaya Oblast), Crimean hemorrhagic fever (Kzyl-Ordinskaya and Chimbentskaya oblasts) and Omsk hemorrhagic fever (Severo-Kazakhstanskaya Oblast).

Serological methods proved the possibility of infection caused by the West Nile virus and the active circulation of the group B arbovirus, which has an antigenic relationship to the West Nile and Dengue-2 viruses (S. K. Karimov and coauthors). The results of a study of 402 blood serums of 59 species of wild birds of the Eastern Aral region attest to the fact that the fowls of this region come into contact with arboviruses of groups A and B (A. V. Survillo and coauthors).

Since no systematic study was made of the arthropod vectors and vertebrates on the huge territory of the planned route of the canal, then, taking into consideration their multi-specied composition and optimum temperature conditions, one may assume the circulation among them of a number of arboviruses and particularly viruses that are ecologically connected with ticks. Among these are included, particularly, the Russian tick-borne encephalitis virus, the principal vectors of which, *Dermacentor marginatus* and *D. pictus*, are predominant in the forest-steppe and steppe zones. In the forest-steppe zone of Kustanayskaya Oblast, bordering Severo-Kazakhstanskaya Oblast, one may assume the existence of focuses of Omsk hemorrhagic fever, the pathogen of which has repeatedly been isolated from the ticks *D. pictus* and *D. marginatus* (M. P. Chumakov and coauthors).

As was pointed out above, cases of Crimean hemorrhagic fever were recorded in Kzyl-Ordinskaya and Chimbentskaya oblasts. Apparently the geographic range of the Crimean hemorrhagic fever virus is more extensive than the

disease, and encompasses not only the desert and semi-desert zones, where the main vectors are considered to be the ticks of the *Hyalomma* genus, but also the steppe and forest-steppe zones, where the ticks *D. marginatus*, *Rhipicephalus rossicus* and *Rh. turanicus* are widespread, and also play a certain role in the ecology of this pathogen.

In the regions situated along the route of the canal, one should expect the possibility of the existence of such natural focuses of arboviruses as the Bad-Medan', the West Nile, Kvaranfil, and arboviruses new to science, isolated in the last few years--Karshi, Batken, Chim, Tandy (D. K. L'vov and coauthors) and others, related to hard and soft ticks.

Medically important in the canal's construction regions are blood-sucking mosquitoes, of which there are over 50 species and 6 genera there. As is known, the greatest number of arboviruses (56%) are bred from mosquitoes (D. K. L'vov, A. D. Lebedev), and in most cases from mosquitoes of the genera *Culex* and *Aedes*, of which there are respectively 8 and 31 species in Kazakhstan.

An analysis of the geographical distribution of the arboviruses carried by mosquitoes showed that under the conditions of the continental climate of the central latitudes of the northern hemisphere, the northern boundary of their possible dissemination is determined by the length of the period with temperatures over 10° (D. K. L'vov and coauthors). On the proposed route of the canal, the sum of the temperatures during the period with temperatures above 10° varies from 2100 in the forest-steppe zone to 4000° in the desert zone, which indicates the presence of one of the main abiotic factors for circulation of arboviruses.

Irrigating the arid lands may lead to favorable conditions for the breeding of mosquitoes and turning a potential focus into an active focus of infection. In addition, irrigating the huge territory will entail an increase in the number and species composition of migratory birds, which carry the arboviruses from other countries and continents.

The increase in the number of vectors and their feeders, the influx of migratory birds and the favorable climatic conditions may result in the rise of new or activation of already existing natural focuses of especially dangerous transmissible virus infections. Therefore, one of the tasks facing the public health organs is to ascertain and study the natural focuses of arbovirus infections and subsequent improvement of their sanitary conditions. A study of the focuses of arbovirus infections should be made in accordance with a comprehensive program and include methods of epidemiological, zooparasitological, virological and serological investigations.

Suspicion of an arbovirus infection should be aroused with the appearance of outbreaks of diseases and the spring-summer and early autumn periods, or of sporadic morbidity, occurring with the symptoms of encephalitis,

meningitis, a hemorrhagic syndrome, general febrile diseases with eruption, lymphadenitis, pains in the joints and muscles, and in some cases--only with a rise in temperature. The clinical picture of arbovirus infections varies from severe cases with a fatal outcome to inapparent forms. These features give rise to the need to use laboratory methods when making the diagnosis. Only on the basis of isolating the virus from the patient or increasing the titers of antibodies in paired blood serums taken in the early period and the period of convalescence (after 2-4 weeks) can a reliable etiological diagnosis be formulated with any arbovirus infection.

Ascertaining and dynamic investigation of the focuses of arbovirus infections create the possibility of predicting and working out prophylactic measures to protect the population against especially dangerous natural focuses of viral infections.

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BRUCELLOSIS MYOCARDITIS--SYMPTOMS AND TREATMENT

Alma-Ata ZDRAVOOKHRANYENIYE KAZAKHSTANA in Russian No 6, 1979 pp 44-47

[Article by T. T. Dzhangaliyev, Department of Infectious Diseases (head--Docent K. A. Zhumanbayev) of the Karaganda Medical Institute]

[Text] There is contradictory information in the literature concerning the frequency of myocarditis of brucellosis etiology (G. F. Barbanchik, Z. S. Zakhar'yan, V. N. Leyman and others). Despite the controversial questions as to the frequency of myocarditis with brucellosis, researchers are in agreement on the frequent serious damage done to the cardiac muscle, resulting in cardiac insufficiency.

We diagnosed myocarditis in 22 out of 321 brucellosis patients from 7 to 72 years of age. Acute brucellosis was established in 14 persons, subacute --in 5 and exacerbation of chronic--in 3 persons. The diagnosis of brucellosis was confirmed by clinical-epidemiological data, serological reactions, Burne's test and screenings from the blood of brucella.

The clinical signs of myocarditis of brucellosis etiology may often be scarcely perceptible, limited only to a few subjective symptoms, or more rarely--serious. The patients complain of: tiring quickly, sweating, palpitation, dyspnea and frequently sensations of pain in the area of the heart. Since myocarditis occurs against a background of brucellosis infection, complaints about tiring quickly and sweating may be caused by the effect of this infection on the organism as a whole. Such signs of a disorder in cardiac activity as palpitation and dyspnea, intensified with even the slightest load, frequently appear after a reduction in temperature and symptoms of intoxication. The painful sensations in the heart area are weak and vague in nature, and are more often aching and constant. The appearance of these pains is probably connected, not with a disorder of the coronary blood circulation, as in stenocardia, but with tissue hypoxia and oxygen deficiency of the entire cardiac muscle resulting from the diffuse damage of the myocardium.

In an objective study, attention is drawn by the paleness of the dermal integument and visible mucosa. In cases of critical brucellosis there may

be skin eruptions, hemorrhages in the mucous membranes and other manifestations of hemorrhagic diathesis resulting from pathological changes in the blood capillaries. With developed cardiac insufficiency (5 persons), swollen neck veins become noticeable. The pulse in most of the patients has a low volume and is sometimes arrhythmic; the arterial pressure is lowered (because of the systolic pressure) with low pulse amplitude. Dilation of the heart on the left side was observed in 16 patients, and on both sides—in 6. In all the patients (with the exception of three) dull heart sounds were observed, particularly the first, which is characteristic of brucellosis myocarditis, with the weakening of the first sound apparently caused by the weakness of the cardiac muscle, and the weakness of the second—by a reduction in arterial pressure occurring as the result of weakening of the systoles. In one patient (8 years) a galloping rhythm was heard at the apex of the heart. In most of the patients (68.1%) with clinical myocarditis a short, blowing systolic murmur of muscular origin was heard, combined with the accentuation of the second sound above the pulmonary artery.

We were able to observe the picture of marked cardiac insufficiency in myocarditis in five patients (three with subacute and two with chronic brucellosis), and congestive phenomena developed in the systemic circulation (enlargement of the liver, slight edema in the legs), which, however, is not characteristic of acute myocardia, since these symptoms more often appear in the chronic course of this disease.

Electrocardiographic irregularities, ascertained by us and noted in the literature, indicate the varying pathology and variability of the signs. Disorders in the cardiac rhythm, a characteristic sign of myocarditis, may be encountered in the form of sinus tachycardia (seven persons), sinus bradycardia (three persons) and in the form of extrasystole (three persons). Particularly characteristic of cardiac muscle inflammation is a slowing of the atrioventricular conduction, which is expressed by the lengthening of the P-Q interval from 0.2 seconds to 0.6 seconds (with the norm being 0.12 seconds–0.18 seconds), observed in 6 out of 22 patients. A result of the diffusive-dystrophic processes in the myocardium may be a reduction in the voltage of the waves of the electrocardiogram, particularly of the ventricular complex, observed in 12 patients; flattened and negative P and T waves in leads II, III, aVF and  $V_1$ – $V_4$  are often encountered; a shift of the RS-T segment below the isoelectric line in I, II and in  $V_{5,6}$  leads are also often encountered.

A phonocardiogram (apex of the heart) reveals in most of the patients (15) a reduction in the intensity of both sounds; a systolic murmur, low-amplitude, low- and middle-frequency of irregular intensity and duration. The first sound of reduced amplitude and a split second sound with greater amplitude were determined in three patients with a serious course of myocarditis.

The signs of cardiac muscle damage enumerated above correspond to the clinical picture of diffuse myocarditis; the diagnosis of focal myocarditis is based, in addition to the dullness of the sounds and the irregularity in the rhythm, most often on the detection of pathologically changed waves and intervals on the electrocardiogram.

All the patients (with the exception of two with chronic brucellosis) had fever of varying type and duration; leukopenia, neutropenia, lymphocytosis, and sometimes—eosinophilia at the height of the disease were observed. Leukocytosis and an elevated erythrocyte sedimentation rate were noted in individual patients. In many of them there was a build-up of the  $\alpha_2$ ,  $\beta$ - and  $\gamma$ -globulins; the albumin-globulin factor dropped; the DNA test and aspartic-glutamic transaminase reacted with a slight increase. The S-reactive protein became positive, sometimes sharply positive.

The treatment for myocarditis of brucellosis etiology is made up of a number of measures. First of all, a patient with myocarditis needs complete bed rest, and this regimen should be adhered to without deviation until all the acute manifestations of the disease have been eliminated, particularly the arrhythmia and symptoms of cardiac insufficiency. A patient with rheumatic carditis should not be given too much to eat, and it is best to feed him small portions more often. The food should be full-valued, with an adequate amount of proteins, carbohydrates and vitamins, particularly vitamin C. The treatment for brucellosis myocarditis is carried out according to the same rules as that for brucellosis. Etiotropic, antibiotic treatment is indicated in acute and subacute brucellosis, and in chronic—only in cases of reinfection or exacerbation with marked signs of activity (elevation of the temperature to the subfebrile level or higher, enlargement of the liver and spleen, presence of metastatic foci of infection, increase in the titer of serological reactions, etc.). Antibiotics (chloromycetin, tetracycline, streptomycin, etc.) are prescribed intermittently for five-seven days, with similar intervals. Depending on the effectiveness and the individual tolerance, deviations from this pattern are permissible. Proceeding from the idea that the basis of most cases of myocarditis with different infections is a state of heightened sensitivity (sensitization) of the myocardium, corticosteroids were administered to the patients (17 persons). Usually average doses of steroid preparations were prescribed (per day): prednisolone—20–30 mg, dexamethazone—1.5–3 mg. The period of treatment and the dosage were chosen according to the serious degree of the disease and the special characteristics of the convalescent phase. The doses should be decreased gradually, particularly at the end of the course. For example, it is recommended that the dose of prednisolone be reduced to 2.5 mg (half a tablet a day). The expediency of administering corticosteroids is also dictated by the fact that they also have a marked anti-inflammatory effect. Cardiac glycosides (strophanthin, corglycon, digoxin, isolanid, etc.) were prescribed for practically all the patients with signs of circulatory disorder, including those with disorders in the rhythm, conductance and contractility. In view of the great activeness and rapid action of these preparations, caution and precision

are required in the dosage and readings. Vitamins, adenosine triphosphate, muscle adenylic preparations, cocarboxylase and calcium preparations were prescribed for all the patients in order to affect the metabolic processes in the myocardium.

Clinical-phonocardiographic and electrocardiographic observations during and after treatment showed that the organic changes revealed in most of the patients (16) underwent a positive dynamic process, i.e., an improvement in the sonority of the heart sound, disappearance of systolic murmur, elimination of the signs of circulatory disorder, etc. were observed. The electrocardiographic signs of diffuse damage to the myocardium were more persistent.

### Conclusions

1. Myocarditis of brucellosis etiology is encountered relatively frequently (in 22 out of 321 patients, which constitutes 6.8%). Characteristic signs of cardiac damage in patients suffering from myocarditis are: enlarging of the heart borders, systolic murmur of muscular origin combined with an accentuation of the second type over the pulmonary artery.
2. Diagnosis of myocarditis should be based on the results of both clinical and electrophonocardiographic studies.
3. In the group of therapeutic measures, the best results are obtained from combined administration of antibiotics, corticosteroids, cardiac glycosides and calcium preparations.

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## INDUSTRIAL MICROBIOLOGY

### SPECIALIZED ENZYME PLANT, APPLIED ENZYMOLOGY INSTITUTE OF VILNIUS

#### Enzyme Plant Described

Vilnius, VALSTIECIU LAIKRASTIS in Lithuanian 26 May 79 p 4

[Article by C. Rimantas: Where The Enzymes "Grow"]

[Text] Huge, silvery reservoirs, elaborate mazes of large and small pipes. You walk through the shops of the large plant and are surprised, it is so clean and quiet here, as if you were in a scientific laboratory.

"This is nothing unusual, a very special environment is needed where micro-organisms are 'grown'," says Ignas Kiudulas, chief engineer of Vilnius experimental plant of industrial enzyme preparations.

We are in the "heart" of the plant, the enzyme shop. To this shop comes through the pipes the "food" prepared for the bacteria. Here it is sterilized, all foreign bacteria destroyed. In the reservoirs, in suitable media and under the most sterile conditions the special bacteria, grown in laboratories, is "sown." Finding themselves in the favorable environment, they multiply very rapidly, "devour" the media and produce... enzymes. Liquid substance is converted into powder which is then mechanically bagged. The technological process is done by automation, the equipment functions precisely, like a clockwork.

The director shows samples of plant production -- enzyme preparations, arranged on glass shelves. Ordinary greyish, brownish powder which contains, however, an enormous power.

Here is a preparation with the elaborate name of "Amilosubtilinas G3X." It is added to feed compound. The weight gain of farrows or calves fed with such feed can be raised by 10 to 15 percent. Economists have calculated that 1 kg. of such preparation gives an additional 21 kgs. of beef or 8 kgs. of pork! Another preparation, the "Protosubtilinas G3X," is most suitable in fish hatcheries: 1 kg. of this preparation gives an additional 30 kgs. of fish! Neither baking of bread, processing of cheese, nor brewing of beer can be managed without enzymes. Enzymes not only speed up the process, they also improve the flavor and aroma of food products.

This "miraculous powder" has now learned also other "professions." In the plant we were shown strips of leather which at the first glance appeared identical. Only by touching them were we convinced that one was hard, stiff and the other pliable and soft. It turns out that the second piece had been treated with enzymes produced by Vilnius workers. They have also been commended by the specialists of primary flax processing: Small doses of enzymes have shortened the technological process, have improved the quality of the fiber. The plant production promises great perspectives for textiles, everyday chemistry, and other branches of industry.

Recently a large scale scientific center, the Union Research Institute of Applied Enzymology was established near the plant. Here even more effective enzymes are being created. They will be used in scientific research, medicine, and gene engineering.

One of the first innovations is the compound of enzymes created together with Byelorussian scientists, which breaks down yeast cell walls. Yeast with "undressed" cells is much better assimilated by animals, therefore, their weight gain is even more increased. It will also be of help to confectioners, who up to now have been using mainly regular sugar. Sugar absorbs moisture and crystalizes, therefore, sugar products do not keep well. Now we will have sugar without these defects and cakes and pastries baked with it will stay fresh for months.

...In the large reservoirs night and day man's little helpers, the industrious bacteria are toiling. They produce preparations which are so necessary to men.

#### New Enzyme Discoveries

Vilnius TIESA in Lithuanian 9 Jun 79 p 2

[Article by Terese Keziene: Scientific Horizons: The Dwarfs With The Might Of A Giant]

[Text] Three young scientists have returned from Moscow. They studied with the country's most famous specialists. Henrikas Piesliakas and Algirdas Valiulis studied chemistry of organic compounds. They were guided in their work by Professors S. Rogozhin and V. Davankov. Juozas Kulys attended the lectures of I. Berzin and N. Semionov, who organized the chair of Kinetics of Chemical Reactions -- a true school in this field and the only such in the world.

All three returned with candidate of science degrees but without having satisfied their thirst for research, their eagerness. The new wave of enzyme research which washed across the world at the end of the 1970's touched them too. It touched them, bewildered them, and would not let them go.

Some people compare an organism to the most complicated airplane of today, others compare it to the most advanced plant. Tens of thousands of reactions occur in it simultaneously, creating the basic life matter - proteins.

Everything happens very quickly. In a laboratory the synthesis of proteins requires several months of intense work, while living systems produce it in several minutes.

Enzymes drive, stimulate all this complicated process. In each reaction, always different enzymes.

Enzymes is an unusual matter. It is almost pure proteins. It fascinates scientists as an interesting research subject and as a research tool for other branches of science.

The scientists of the Institute of Biochemistry of the Academy of Sciences of the Lithuanian SSR have also for some time now looked with curiosity at enzymes. Investigating the nature of leukemia, developing anti-cancer drugs, revealing the role of vitamins, they always came to the activity mechanism of enzymes, so far still unknown. It was no secret to anyone that although chemistry of enzymes was still taking its first steps, it had a great future. Another problem is the question how much time and effort will this work demand. For a century and a half man has tried to apprehend the world of enzymes but up to now very much is still not understood. So complex is the problem of enzymes.

Biologists looked for enzymes in animal muscle, heart, kidney, liver, and brain; they looked in plant cells and microorganisms. They always discovered more and more new enzymes. In 1930 there were already 80 known enzymes, in 1957 there were 660 and in 1968 -- 1,300 enzymes were known. They rejoiced in discovering them, investigated their activity, looked for possible applications and complained that enzymes were so fragile, immediately disintegrating. The scientists wanted to but could not arrest the moment.

In the late 1970's chemists, interested in the problem of biocatalysis, enter the arena. They are accustomed in working with stable compounds which can be stored indefinitely, which can be used in any conceivable manner.

"Enzymes are unstable? Let us stabilize them!" becomes the slogan of the chemists.

The steric structure of enzymes is already known. It is like a building which already can be inspected, touched; which of its corners are weaker and which are rigid; what can be attached to it and what can be split off. That is the key to enzymes' chamber of secrets. The young scientists Juozas Kulyse, Henrikas Piesaliakas, and Algirdas Valiulis also want to try their discoverer's luck here.

It happens in life that roads meet and then part again. A specialized enzyme plant, the first such in the country, is being constructed in Vilnius; the Union Institute of Applied Enzymology is being formed. The

plant and the new institute need specialists. In the sector of Enzyme Chemistry, created at the Institute of Biochemistry, remains only Juozas Kulys, the young chief of the young collective.

The longer an enzyme is active, the greater the probability that its structure will change, that is will lose its marvelous capability. And so it happens, enzymes disintegrate.

Yeast is the cheapest product containing an active enzyme. Generally, to obtain pure enzyme is very difficult; 1 gram costs a few or even several thousand rubles, yet without enzymes can manage neither food nor light industries, nor agriculture. They are needed to produce butter, cheese, canned foods, and bread; they enrich feed and soften processed leather. A newly discovered and applied enzyme is a new possibility to change and improve technology.

One thing is to discover new enzymes, another not to allow them to disintegrate, to stabilize them.

"There is a continuous regeneration process in a cell. It is and then it is reborn anew. Enzyme is part of the cell. Therefore, it too regenerates continuously, one could say lives forever or at least while the organism is alive. How to prolong the life of the enzyme separated from the cell? Chemists looked at enzymes as catalysts which had to be immobilized."

So explains Juozas Kulys, chief of the sector. He explains and points out the complex laboratory apparatus, the flask after flask, the equipment.

An immobilized enzyme, what is it? It is the same enzyme only bound to a certain matter -- polymer, one could say packed into its pores. The pores do not prevent the enzyme from contact with solution, from reacting but they do not allow it to dissolve, to disintegrate.

Science knows of two methods of enzyme immobilization. One is physical, where the enzyme is imbedded, as if with a hammer, into the porous polymer. This binding of enzyme and material is unstable. The other method is chemical binding. It is much superior because the linkage between the enzyme and polymer is very stable, does not break down even after long use. The problem is that by immobilizing the enzyme, its activity is weakened. To find the happy medium where the enzyme is stable and active is not so simple.

Now, ten years after the initial development and research of immobilized enzymes, there are almost 100 of them. Many suitable materials for enzyme immobilization have been tested and adapted, several techniques of chemical immobilization have been developed.

But back in 1974, when the new sector was organized at the Institute of Biochemistry, the creation of stable enzymes was still an enigma. To Juozas Kulys, the immobilization of enzymes, which are so complex, responsible for most important functions of life such as synthesis of matter, was of great interest.

Flasks with sub-unit enzyme, the glucose oxidase, for years did not leave the benches of scientific co-workers Bogumila Kurtinaityene and Vladas Laurinavicius. There were disappointments but even more joy.

"We have succeeded in proving," says Juozas Kulys, "that glucose oxidase becomes inactivated just because it splits into sub-units. One separate unit is nothing. Yet, even without that unit the entire enzyme is also nothing. Such is the property of this class of enzymes: They function only when all units are together and form a specific complex. When we grasped this, we were able to set a certain goal -- not to allow the enzyme to split into sub-units."

Thus for the first time were created immobilized sub-unit enzymes. The glucose oxidase, which formerly could remain active only three days, now serves 3,000 days.

Enzymes are expensive. Coenzymes are ten times more expensive. And not only because they comprise only a few percent of the enzyme. Just as the enzyme is inactivated without one of its sub-units, so it loses power without the coenzyme. Again Vilnius scientists take a turn on the difficult road of research. Again they succeed. They devise chemical methods of coenzyme reconstruction.

Theory. Research. Application. That always excites scientists and society. The transformation of the principles of live organisms into models, their systems, always was a big step toward advancement, toward new technologies. The immobilized enzymes help identify matter, complex physiological solutions, they serve in analysis, take part in synthesis processes and in the creation of reagents. With all this, their possibilities are still not exhausted.

Enzymes, released from the cell into the world, began performing miracles, one after another. Who could have imagined that it would be possible to prepare food from wood, hay, paper... By adding the enzyme cellulase to these materials, the cheapest glucose is manufactured. Its production -- an automated, technological system -- is closed, without wastes polluting the environment.

Enzymes can change glucose into fructose, a much more soluble, sweeter product. Artificial proteins can be produced from glucose. It appears that this enzymatic process will spread widely because the world already feels the lack of proteins.

The world is even more concerned about energy supplies. Coal and oil are being replaced by energy produced by atomic power plants. But this is not the best substitute. A great problem is how to preserve the underground water supplies from pollution by radioactive wastes. Not a lesser problem is the heat radiated by these power plants, which could change the earth's climate. The task for science, therefore, is to find new energy sources.

Every second the sun sends to the earth 40 trillion kilocalories. Although only half of this energy reaches the earth, it equals all the fuel used during one year on the whole planet. How to harness this energy?

A green leaf of a plant, without much effort, appropriates the energy of sun rays and by means of photosynthesis and with the help of enzymes, transforms it into chemical energy. Although the photosynthesis process in plant cells has not yet been fully explored, the scientists are already proffering the thought, is it not possible to collect solar energy in a similar manner?

Why is science always looking toward the living world? Throughout millions of years evolution has improved the living systems, has taught them to perform economically, almost without waste to transform one type of energy into another.

On a summer night, in the darkness of a forest, twinkle little flames.

"The fireflies are dancing the fairy tale dance," parents tell their little ones.

"Luciferin is oxidizing," explain the scientists.

Luciferin is organic matter. The oxidation reaction occurs with the help of enzymes. The chemical energy becomes light. And as it usually is in nature, the energy loss is very slight, the beneficial performance level is 80 percent. As a comparison, one may say that by the time a light bulb lights up, more than 90 percent of energy has been lost.

If we succeeded in our lifetime to light up the firefly's lamp, completely new sources of light would open up...

Each enzyme is like an invisible dwarf under a spell. Guess the secret word and the dwarf will not only appear but will also begin to serve you.

Science has already succeeded to discover 3,000 enzymes. And how many more remain is still unknown? We believe an infinite number if even in the cell of the simplest bacteria there are thousands of them.

7147

CSO: 1809

PRELIMINARY DATA ON RACIAL COMPOSITION OF CROWN RUST OF OATS IN THE  
LITHUANIAN, LATVIAN, ESTONIAN AND BELORUSSIAN SSRs IN 1974-1975

Vilnyus TRUDY AKADEMII NAUK LITOVSKOY SSR SERIYA B in Russian No 3 1979  
pp 39-41 manuscript received 23 Nov 78

[Article by B. P. Namayunas, Institute of Botany, LithSSR Academy of  
Sciences]

[Text] I. Introduction

It is known that the causative agent of crown rust of oats (*Puccinia coronata* f. sp. *avenae* Pr. et Led.), like many other rust fungi, is a representative in nature of a heterogeneous population composed of various races which infect, differently, the individual sorts of oats. In this connection, successful isolation of sorts resistant to crown rust requires constant study of the racial composition of the agent and the geographical distribution of the races.

Study of the racial composition of oat crown rust in Lithuania has been carried out by us, starting in 1967. /1-3/

On the basis of an agreement with selectors and phytopathologists of the Lithuanian, Latvian, Estonian and Belorussian SSRs, the Institute of Botany, LithuanianSSR Academy of Sciences has been carrying on studies, since 1974, of the racial composition of crown rust of oats in the mentioned region.

Goal of the work was study of races of crown rust of oats in LitSSR, LatvSSR, ESSR and BSSR.

2. Research Methodology

Studies completed earlier of physiological races of crown rust of oats have indicated that their virulence on standard differentiator sorts is constantly increasing. In this connection, and, also, in connection with the fact that the association of resistance and heredity in the set of differentiator sorts has been insufficiently clarified, Canadian scientists /4/

suggested, in 1971, as a new standard set, 10 lines of a susceptible sort of oats, Pendek, with single genes of resistance (Pc-35, Pc-38, Pc-39, Pc-40, Pc-45, Pc-46, Pc-47, Pc-48, Pc-49, Pc-50) discovered in *Avena sterilis* and transmitted via back-crossing into the individual lines of this sort. Sources of the genes of resistance of *Avena sterilis*, composing the latter set, have been termed set "C", so as not to confuse them with the last-but-one set "B". To determine the number of the race, the authors of the cited work suggested numbering of a race according to the decimal system of numeration:  $N = 1 + 512x_1 + 256x_2 + 128x_3 + 64x_4 + 32x_5 + 16x_6 + 8x_7 + 4x_8 + 2x_9 + x_{10}$

where: N--number of race, 1--magnitude increased so that the universal avirulent race was titled C1;  $x_1-x_{10}$ --are the isogenic lines with homogeneous genes of resistance, respectively Pc-35, Pc-38, Pc-39, Pc-40, Pc-45, Pc-46, Pc-47, Pc-48, Pc-49, Pc-50; x has the value 1 if the line is susceptible, and the value 0 if the line is resistant.

The questions indicated have been described in more detail by Fleischman, Baker /4/ and Zhemchuzhina /5/.

Samples of rust were collected, in 1974-1975, in Radvilishkiy, Panyavezhkiy, Plungeskiy, Kryatingskiy, Raseynskiy, Kaunasskiy (LitSSR), Yelgavskiy, Stuchkinskiy, Tsesisskiy, Telsinskiy (Latv SSR), Yygevaskiy, Vil'yandskiy, Kharyuskiy, Vyruskiy (ESSR), Vitebskiy, Gomel'skiy and Minskiy (BSSR) rayons in productive plantings of oats and, also, in collected crops of experimental establishments. Race identification was carried out on the last (III) international set, in the composition of which there are 10 isogenic lines. Seeds of the isogenic lines were obtained from the All-Union Scientific Research Institute of Phytopathology.

### 3. Results and Their Discussion

Of 63 isolates collected in 1974-1975 in the cited rayons of the Lithuanian, Latvian, Estonian and Belorussian SSRs, 12 physiological races of *P. coronata* f. sp. *avenae* were identified in 1976 (Tab. 1).

Table 1

Races of crown rust of oats, identified in 1976 from infected material collected in 1974-1975 in Lithuanian, Latvian, Estonian and Belorussian SSRs

1. № race	2. Сорт-дифференциатор									
	Pc-35	Pc-38	Pc-39	Pc-40	Pc-45	Pc-46	Pc-47	Pc-48	Pc-49	Pc-50
C9	R	R	R	R	R	R	S	R	R	R
C265	R	S	R	R	R	R	S	R	R	R
C269	R	S	R	R	R	R	S	S	R	R
C283	R	S	R	R	R	S	S	R	S	R
C289	R	S	R	R	S	R	R	R	R	R
C291	R	S	R	R	S	R	R	R	S	R
C521	S	R	R	R	R	R	S	R	R	R
C777	S	S	R	R	R	R	S	R	R	R
C779	S	S	R	R	R	R	S	R	S	R
C793	S	S	R	R	R	S	S	R	R	R
C799	S	S	R	R	R	S	S	S	S	R
C809	S	S	R	R	S	R	S	R	R	R

Key. 1. No of races 2. Differentiator sorts

Identified in LitSSR were races C265, C283, C284, C521, C777, C779, C793, C799, C809 (with 30 monouredo-proven cultures); LatvSSR, C777 (with 5 monouredo cultures; in the ESSR, C9, C269, C777, C265 (with 15 monouredo cultures); and, in the BSSR, C287, C291, C777, C793 (with 13 monouredo cultures).

Of the identified races, the race of crown rust of oats C777, was common to all republics; C289 and C793 were common to LitSSR and BSSR; C265 was common to LitSSR and ESSR. Identified only in the LitSSR were the races C283, C521; only in the ESSR, C9 and C269; only in BSSR, C291. The most distributed race of the number identified was race C777, while the most virulent, infecting six differentiator sorts, was race C799.

#### 4. Conclusions

1. Based on preliminary data, among the 63 isolates collected in 1974-1975 with monouredo cultures in productive plantings of oats, and also in collected drops of experimental establishments in the Lithuanian SSR (Radvilishkiy, Panyavezhkiy, Plungeskiy, Kryatingskiy, Raseynski, Kaunasakiy rayons), in the Latvian SSR (Yelgavskiy, Stuchkinskiy, Tsesiski, ...)

Talsinskiy rayons), in the Estonian SSR (Yygevaskiy, Vil'yandskiy, Khar'yuskiy, Vyruskiy rayons) and in the Belorussian SSR (Vigebkiy, Gomel'skiy, Minskiy rayons), identifications were made in 1976 of the following 12 physiological races of crown rust of oats (*Puccinia coronata* f. sp. *avenae* Fr. et Led.): C9, C265, C269, C283, C289, C291, C521, C777, C779, C793, C799 and C809.

2. Of the number of identified races, the most widespread was race C777 and the most virulent, C799.

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DISTRIBUTION OF THE FRUIT FLY RHAGOLETHIS ALTERNATA FLL. IN THE LITHUANIAN SSR AND THE EFFECT ON IT OF ENTOBACTERIN-3, BITOXYBACCILLIN AND BOVERIN

Vilnyus TRUDY AKADEMII NAUK LITOVSKOY SSR SERIYA B in Russian No 3 1979 pp 43-47 manuscript received 13 Mar 78

[Article by I. S. Misyalyuene, G. K. Zharukas and R. Ye. Grinkevich, Institute of Zoology and Parasitology, LitSSR Academy of Sciences; LitSSR Ministry of the Food Industry]

[Text] 1. Introduction

The fruit of the rugosa rose (*Rosa rugosa* L.), of all the berries and fruits used in the food industry, contains the greatest quantity of Vitamin C. Despite the fact that our republic, up to 1974, allotted about 207 ha to the rugosa rose, the purchase stations took in on the average 185 t of the rose fruit per year, in a time when they could have taken in 662 t /1/. The fundamental reason for this is that the rose fruit is often damaged by the fruit fly (*Rhagoletis alternata* Fll.), which is the basic pest of the rugosa rose in the Lithuanian SSR /2/. Feeding on the fruit pulp, the fruit fly larvae gnaw away tortuous paths in the fruit and dirty the fruit with their excrement. Such fruit can no longer be used as raw material for the food industry.

To combat rugosa rose pests at the present time chemical insecticides only are being used which simultaneously destroy field fauna and lower the amount of vitamins in the fruit /3/.

Despite the fact that microbial preparations are finding, with each year, wider and wider use to combat pests of agricultural plants, they have not yet been used, as far as we know, to combat the fruit fly, either in our country, or abroad.

The purpose of the present article was to shed light on the distribution of the fruit fly in the Lithuanian SSR and the harm done by it, and, also, to study the effect of microbial preparations—entobacterin-3, bitoxybacillin (BTB-202) and boverin on the fruit fly under conditions in the republic.

## 2. Materials and Procedure

Distribution of the fruit fly in the Lithuanian SSR was established by calculation, in 1976 and 1977, of the number of damaged fruit, both under natural conditions and on cultivated plantations of the rugosa rose, gathered per 100 fruit from 10 bushes in checkerboard order in the following rayons in which the rose is grown: in the Ukmyargskiy, Prenayskiy, Kayshyadorskiy and Vil'nyusskiy rayons.

Laboratory-field trials were carried out in 1977 on cultivated rugosa rose plantations of the Institute of Botany, Lithuanian SSR Academy of Sciences (Varuzale, suburb of Vilnyus).

The bushes of the rugosa rose at the time of intensive feeding and deposition of eggs of the fruit fly were sprayed with aqueous suspensions of entobacterin-3, bitoxybacillin and boverin at concentrations of 0.5, 0.7 and 1.0%, and, also, with pure water (control). Tests were carried out in 5 repetitions for each preparation and each concentration. Spraying was done with a manual sprayer OR-05 (Sh-9). Two liters of suspension each were used to process each rugosa rose bush. The bushes were treated with all concentrations of each preparation, twice. The second treatment of the rugosa rose was carried out 20 days after the first treatment. A recording of the number of damaged rose fruit was carried out 3 and 20 days after treatment I and 20 days after treatment II. For this, a collection was made of 10 fruit each from every treated bush and the number of damaged fruit counted.

## 3. Results and Discussion of Them.

Under the conditions in the Lithuanian SSR, rugosa rose is damaged by 30 species of harmful insects, 15 of which belong to the order Lepidoptera, 9 to the order Coleoptera, and the rest to the orders Hymenoptera, Diptera.

Observations have shown that most harm to rose fruit is caused by the fruit worm (*Grapholita reseticolana* L.) and the fruit fly (*Rhagoletis alternata* Fl.). The imagos of the fruit fly appear in the second half of June. At the beginning of July they begin to deposit eggs in the germs of the rugosa rose and affect them almost until the end of August. Greatest damage to the fruit is seen in the natural thickets of the rose, hence, on cultivated plantings, chemical combatting of the fruit fly is regularly practised (Tab. 1). Natural thickets of rugosa rose, including the rugosa rose growing on the sides of the roads and railroad beds, are one of the basic foci of distribution of the fruit fly and so, for successful control of the fruit fly, it is also necessary to eradicate the fly in the natural bushes of rugosa rose.

The study has shown (Tab. 2) that the microbial preparations entobacterin-3 and bitoxybacillin, in all concentrations used, decreased damage to the rose

Table 1

Distribution of the fruit fly in the Lithuanian SSR in 1977

1. Местонахождение плантации или зарослей	2. Дата проверки	3. Количество плодов	
		проанализированных, шт.	поврежденных, %
Птицеводческий совхоз „Лясиополис“ (Укмяргский р-н)	12.VIII	3500	0,9
Плодопитомник „Даукшягирис“ (Пренайский р-н)	16 „	2200	2,5
Натуральные заросли шиповника			
в Кайшядорском р-не	8 „	1250	56,7
в дер. Реше (Вильнюсский р-н)	17 „	1000	76,4
в Ярузале (пригород г. Вильнюс)	14 „	„	87,8

Key to Table 1

- |                                   |            |                    |
|-----------------------------------|------------|--------------------|
| 1. Site of planting or thickets   | 2. Date of | 3. Number of fruit |
| Poultry sovkhos "Lyaonpolis"      | inspection | ana- damaged       |
| (Ukmyargskiy rayon)               |            | lyzed, # %         |
| Fruit nursery "Daukshyagiris"     |            |                    |
| (Prenayskiy rayon)                |            |                    |
| Natural rose thickets:            |            |                    |
| in Kayshyadorskiy Rayon           |            |                    |
| in Reshe village (Vil'nyuskiy R.) |            |                    |
| in Yarusale (Vil'nyus suburb)     |            |                    |

fruit by the fruit fly. It must be noted that the same concentrations of the different microbial preparations did not act the same on the fruit fly. Thus, from a 5% suspension of entobacterin-3, damage to fruit at the end of the experiment was decreased by 36, from the same concentration of boverin by 16 and by bitoxybacillin by 56%. The higher the concentration of the preparation, the lower was the fruit damage. A 0.7% suspension of entobacterin-3 lowered the rose fruit damage by the fruit fly by 44, a 1% suspension by 48%. The same concentrations of boverin and bitoxybacillin lowered fruit damage, respectively, by 18-26 and 62-66%.

All used microbial preparations decreased, especially strongly, the injury of the fruit by the fruit fly during the first days after treatment I of the rugosa rose. Three days after treatment I, entobacterin-3, depending on the concentration used, lowered the fruit injury by 34-46, boverin by 40-48 and bitoxybacillin by 24-42%. In the control variant, 20 days after treatment I, 82% of the fruit was damaged by the fruit fly, in the same time that 30-46 was damaged in the variant with entobacillin-3, 26-52 with boverin, and 22-36% with bitoxybacillin. From 4 to 20 days after treatment I, almost the identical amount of rose fruit was injured by the fruit fly in the control variant and in the variants with the microbial preparations. Thus, in the control, in this time, the amount of damaged fruit rose by 26,

Table 2

Effect of entobacterin-3, boverin and bitoxybacillin on the fruit fly under laboratory field conditions in 1977

1. Вариант опыта	2. Концентрация, %	3. Количество поврежденных шиповниковой мухой плодов (%) через		
		3	20	20
		дней после		
		I обработки		II обработки
Энтобактерин-3	0,5	22	46	50
	0,7	14	34	42
	1,0	10	30	38
Боверин	0,5	18	52	70
	0,7	12	36	68
	1,0	8	26	60
Битоксибациллин	0,5	32	36 (56)	30
	0,7	16	20 (62)	24
	1,0	14	22 (49)	20
Чистая вода (контроль)		56	82	86

Figures in parentheses indicate the total percent of damaged rose fruit, and the numbers before the figures in parentheses the percent of damaged fruit in which live larvae of fruit flies were found.

## Key to Table 2

1. Variant of test	2. Concentration (%)	3. Number of fruit (%) injured by the fruit fly,
entobacterin-3		3    20    20
boverin		days after
bitoxybacillin		treatment I    treatment II
pure water		

after processing with entobacterin-3 by 20-24, boverin by 18-36 and bitoxybacillin by 24-35%. It must be noted that the lesser concentrations of biopreparation used to treat the rose fruit the greater the number of fruit injured by the flies. This can, probably, be explained in that the higher the concentration of preparation used, the longer time the smell and the white color were retained in the bushes of the rugosa rose, and this frightened off the fruit fly. After treatment of the rose with entobacterin-3, the bushes became white from the koalin used as an additional component of these preparations. The suspension of bitoxybacillin is colorless and has a specific odor which frightens off the fruit fly to a lesser degree hence

the rose fruit 3 days after treatment with this preparation was damaged 6-16% more than 3 days after treatment with the corresponding doses of entobacterin and boverin. Total damage of the fruit 20 days after treatment I with various concentrations of bitoxybacillin was higher than after treatment with entobacterin and boverin. However, it must be noted that 20 days after treatment I with bitoxybacillin, 35.5-67.8% of the fruit had clear external signs of damage but the larvae and eggs of the rugosa rose were killed. This is explained in that at the time of deposition of eggs the exotoxin of the preparation, present on the treated fruit, gets inside the fruit and destroys the egg or the already spawned larva.

Twenty days after treatment II, damage to the rose fruit in the control variant had increased by 4, after processing with various doses of entobacterin by 6-8, and after processing with boverin by 18-46%. This can be explained in that the fruit fly can distinguish healthy fruit from the already damaged fruit and tries to deposit its eggs in the as yet uninjured fruit. It can also be explained in that the lesser the fruit injuries were after treatment I, the greater the injuries later. This was especially noted after treatment of the rose with various doses of boverin, the specific odor and color of which dissipate more rapidly than the odor and color of entobacterin. At the end of the experiments the rose fruit treated with various doses of bitoxybacillin showed less damages. This is explained in that this preparation has not only a specific odor, which frightens off the fruit fly, but, also, an ovocide action, thanks to which it destroys a percent of the eggs or the already spawned larvae. The rose fruit in which the eggs or larvae of the fruit fly had died did not differ, in autumn, at all from the non-damaged fruit, hence they are regarded as undamaged.

The data presented indicate that, of the microbial preparations used, entobacterin-3 and, especially, bitoxybacillin at concentrations of 0.5-1.0%, lower, to the greatest degree, the damage of rugosa rose fruit by the fruit fly.

#### 4. Conclusions

1. Thirty species of harmful insects were registered on cultivated plantations and on natural bushes of the rugosa rose in 1976-1977, in the Ukmyarg-skiy, Prenayskiy, Kayshyadorskiy and Vil'nyusskiy Rayons of the Lithuanian SSR. Of these, the most harm was done by the fruit fly (*Rhagoletis alternata* Fl.) (damage by it to the rose fruit on natural bushes was 56.7-87.6 and, on cultivated plantings, 0.9-2.5%).
2. Laboratory-field experiments, carried out in 1977 on cultivated plantations of the rugosa rose, of the Institute of Botany, Lithuanian SSR (Yaruzale, Vil'nyus suburb) showed that, under the same conditions, bitoxybacillin at concentrations of 0.5, 0.7 and 1.0% lowered, more strongly (by 56-66%), the damage to the fruit fly than did entobacterin-3 (by 36-48%) and boverin (by 16-18%).
3. Entobacterin-3 and boverin, with their specific odor and white color,

frighten off the fruit fly, hence, in the first days after treatment they strongly decrease the damage to the fruit. Bitoxybacillin not only frightens off the fruit fly with its odor but also has an ovocide activity in relation to this pest. Depending on the employed concentration of this preparation, 35.5-67.8% of the fruit flies died in the phase of eggs or just spawned larvae.

4. For successful control of the fruit fly it must be destroyed on natural bushes and in protected roadside belts (since they disseminate from such spots to the cultivated plantations), and cultivated plantations of the rugosa rose must be processed with a 0.7-1.0% suspension of bitoxybacillin and entobacterin-3.

[398-8586]

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**AZERBAIJAN MINISTER OF HEALTH FIRED FOR ABUSE OF OFFICE**

**Baku BAKINSKIY RABOCHIY** in Russian 16 Jun 79 p 2

[Text] The Central Committee of the Azerbaijan Communist Party has discussed the question of grave shortcomings in the work of the Azerbaijan SSR Ministry of Health in organization of medical services to the public.

In the resolution adopted it is noted that, as a result of the constant attention and concern of the Communist Party and Soviet government and the practical implementation of the decisions of the 25th CPSU Congress and 29th Congress of the Communist Party of Azerbaijan, important measures regarding the improvement of public health care have been put into effect in the republic. The network of therapeutic-prophylactic establishments has been enlarged; the material and technical resources of these establishments have increased; specialized care has undergone definite development and the number of doctors and other medical workers is growing constantly.

At the same time, existing resources are by no means being fully utilized in the improvement of therapeutic work, strengthening of prophylaxis and raising the quality of medical service to the population. One of the main reasons for this is the presence of grave shortcomings in the work of the Azerbaijan Ministry of Health and the poor organization of work in many of the clinics, hospitals, pharmacies and other medical establishments.

The resolution of the CPSU Central Committee and the USSR Council of Ministers of 22 September 1977, "On Measures for the Further Improvement of Health Service to the Public," is not being carried out satisfactorily. The level of the therapeutic-prophylactic care available to the population is inadequate. The basic indicators of health care for the year 1978 in Azerbaijan are significantly lower than the corresponding mean indicators around the country, especially in the areas of the availability of public health clinics to the population and hospitalization of the ill.

The Azerbaijan Ministry of Health and its local agencies do not concern themselves sufficiently with the organization of work of such vital importance in public health care as emergency treatment, which has a negative effect on the successive treatment of the patients.

There is no strict control of providing the population with medicine. Very little is expected from the directors of medical and pharmaceutical establishments in the way of prompt and high-quality service in the dispensing of medicines and more adequately satisfying the needs of the population for medicines and medical equipment.

There are grave shortcomings in the organization of the sanitary-epidemiological services. Prophylaxis of infectious diseases is badly managed. Strict measures against poor sanitation are not being taken at industrial sites, in communal dining halls, in trade and in the social services. The level of sanitation is low in the majority of the medical institutions themselves. Work concerned with teaching the population about sanitation is poorly carried out.

The network of therapeutic-prophylactic establishments is developing too weakly, especially in rural areas. Completion of the plans for construction and putting the health units into actual operation are not being ensured. From the beginning of the 10th Five-Year-Plan, about R 20,000,000 of capital investment has not been used. The commissioning of 779 beds of hospital capacity and polyclinics able to treat 1250 outpatients was not achieved. With the full cooperation of the Ministry of Health, instances of putting unfinished units into operation and of accepting work of poor quality are allowed.

Sufficient attention has not been given to consolidation of the material and technical resources of public health establishments, to furnishing them with the latest medical equipment. In many therapeutic institutions, a slack, unbusinesslike attitude with regard to the use of expensive medical technology can be observed.

Essential work in the coordination of scientific investigations in the field of medicine, increasing the effectiveness of such investigations and in introducing the achievements of science into public health practice is not being carried out by the Ministry of Health of the republic. Vigorous measures have not been taken for improvement of the activities of the research institutes under its jurisdiction. There are grave shortcomings in the work of tuberculosis, ophthalmology, health resort and physical therapy institutes.

Much of the research being carried out is not adequate for contemporary demands, either in its subject matter or quality. The preparation given scientific personnel in their graduate education is carried out in an unsatisfactory manner. The effectiveness of this preparation is low.

These grave shortcomings in the organization of medical services for the population of the republic are the result of the improper attitude of the leaders of the Ministry of Health towards the resolution of personnel problems.

With the great demand for medical workers, a great number of vacancies in the institutions and organizations of the Ministry of Health are not being filled for long periods of time. No concern is being shown for the creation of a fully-qualified reserve force for promotion into responsible positions. Plans for improving the qualifications of medical workers and for their in-service training are not being implemented. The certification of these workers has only a formal character. Leaders of the Ministry of Health have shown complete indifference to the fact that the number of highly-qualified specialists in the fundamental branches of medicine in the Republic is diminishing noticeably, and they have done nothing to correct the situation. Planning, and work concerned with the preparation and utilization of young specialists is poorly organized. This situation is leading to a serious shortage of doctors in a number of specialties, especially in outlying areas of the republic. There continue to be instances of the unjustifiable transfer of young specialists from rural regions to the city of Baku. As a result of this lack of control, in 1978 one-tenth of the medical institute graduates did not take up duties at the places to which they had been assigned upon graduation.

The leaders of the Ministry of Health allow flagrant violations in the selection and placement of supervisory personnel. In the promotion of workers into supervisory positions, their work attitudes and political and moral qualities are not investigated. Not infrequently in this important matter nepotism and associations among countrymen come to light. No attention whatever is given to support of the moral education of workers and to the creation of a sound moral and psychological climate in every therapeutic-prophylactic establishment. This fact has much to do with the scornful attitude of a certain portion of the medical workers towards observance of the demands of the ethics of the medical profession, socialist law and principles of communist morality. Especially intolerable are the instances in a number of medical establishments of misappropriation, bribery, extortion and the use of one's position for purposes of profit. In the last three years alone, 81 public health workers have been called to account for abuse of position and misappropriation of valuable materials. Among the medical workers who have been called to account for accepting bribes are: the head physician of Medsanchast' No 19 of Narimanovskiy region, Baku, Mr Nazarov; the president of the VKK [medical consultation commission] of the same Medsanchast', Mr Ibragimov; the head physician of Ismailinskaya regional hospital, Mr Akhmedov; and the manager of the Mingechaurskaya city hospital, Mr Salekhov.

In a number of therapeutic establishments in Baku, Kirovabad, Agdam, Yevlakh and other cities and regions of the republic there have been instances of the storing of medicines and their resale at high prices. Foodstuffs designated for inpatients have also been misappropriated.

All this gives rise to justified censure by the population and a great number of complaints to the government of the republic and the country.

A formal and bureaucratic style has taken root in the work of the administration of the Ministry of Health. The Board of the Ministry is remiss in carrying out its responsibilities, in essence showing itself to be in no way involved in the struggle against shortcomings in improving the composition of staff and eradication of existing negative factors. The resolutions adopted by the administration for the most part are vague and are not given support in their implementation through organizational work. The workers in the administration of the ministry have not developed the habit of expecting a consistently high level of performance from each other. The actual level of performance is low, and toleration of shortcomings and negative factors is evident. A purely formal approach to the consideration of complaints and statements of the working people is allowed. Because expectations of high-level performance on the part of the Ministry of the Republic are absent, an atmosphere of complacency and mutual protection has been created in many of the collectives of the medical establishments, and personal responsibility has been narrowed to the state of affairs in the specific area of work to which one has been assigned.

Work in the area of the political and ideological education of the collectives is at a low level. There is no provision for communists' assuming a leading role in the struggle against shortcomings and for strengthening party and state discipline.

There are grave shortcomings in the work of the original Party organization of the Ministry. It shows itself to be weak in improving discipline and organization in the administration of the Ministry of Health and in the political and ideological education of workers, and it does not strive for the development of criticism and self-criticism within the collective.

The Central Committee of the Azerbaijan Communist Party believes that the highly unsatisfactory organization of the work of the republic's medical establishments is explained first of all by the fact that the Minister of Health of the Republic, Mr Abdullayev, and his deputies, Mr Rustamov and Mr Aliyev, do not regard the execution of their obligations with the proper sense of responsibility. They are not carrying out a firm and determined struggle against existing shortcomings. They do not require high-level performance from the leaders of the agencies under their jurisdiction, and they deal in a conciliatory way with incidents of bribery, extortion and other abuses on the part of medical workers.

The attention of the leadership of the Ministry of Health has more than once been directed to the necessity of changing the style and methods of its work. It has been told that it must require a higher level of performance from the agencies under its jurisdiction, take a firm stand in the struggle against negative factors, and to strive actively for their eradication. The leadership has been told to carefully attend to the signals coming to the Ministry from the workers and to react to these signals promptly. In particular, in the resolution of the Central Committee of the Azerbaijan Communist Party of 20 November 1969, concrete measures were specified for the fundamental improvement of the health service for the population.

The leaders of the Ministry of Health have taken a purely formal approach to the implementation of this resolution. Many of the administrative measures envisaged in that document have remained unrealized. These leaders have not drawn the necessary conclusions even from the severe criticisms expressed in an address to the various divisions of the Ministry of Health at the 28th and 29th Congresses of the Communist Party of Azerbaijan, Plenary Sessions of the Central Committee, meetings of the most active members of the party organization, and at Baku party conferences.

Minister of Health G. M. Abdullayev has permitted abuse of his position, aiding in the illegal activities of his relatives and offering them protection.

The Central Committee of the Communist Party of Azerbaijan considers it necessary to note also that party obkom's, gorkom's and raykom's and the ispolkom's of the Councils of People's Deputies do not display sufficient interest in the work of the medical establishments. They do not hold the leaders of these establishments responsible for providing a high level of medical service, and they are not directing the efforts of communists, deputies and society towards the resolute eradication of negative factors and the consolidation of a healthy moral environment in every collective.

The Central Committee of the Communist Party of Azerbaijan has removed Mr G. M. Abdullayev from the position of Minister of Health of the Azerbaijan SSR and issued a severe reprimand. This action has been taken because of Mr Abdullayev's unsatisfactory management of the activities of the Ministry of Health, grave shortcomings in the selection, placement and training of personnel, and a conciliatory attitude towards abuses in the therapeutic-prophylactic institutions.

First Deputy Minister of Health of the Azerbaijan SSR, Mr A. I. Rustamov, has been severely reprimanded for grave shortcomings in the organization of the therapeutic-prophylactic work and evident lack of a sense of principle in the eradication of negative factors.

Deputy Minister G. Z. Aliyev has been reprimanded for grave shortcomings in the organization of the sanitary-epidemiological services and evidence of liberalism in his work.

The board and leadership of the Azerbaijan Ministry of Health must take immediate measures for the all-out elimination of the shortcomings noted in the present resolution, develop and implement concrete measures for fundamental improvement in the organization of the work of the ministry and the agencies under its jurisdiction, and see to an improvement in the quality of medical assistance rendered to the inhabitants. The Ministry of Health must significantly improve therapeutic-prophylactic work, the organization of outpatient and inpatient service to the public, the quality of dispensary and prophylactic examinations and protection of the health of women and children. The effective use of beds in therapeutic establishments must be

ensured and shortcomings in the supply of medicines to the population, the organization of the work of sanitary-epidemiological services and the use of medical technology must be resolutely eliminated. Food service for hospitalized patients must be improved.

The necessary measures must be taken to significantly improve precision and efficiency in the work of institutions which provide emergency treatment, to provide them with well-qualified personnel and to furnish them promptly with up-to-date equipment, supplies and transportation. The republic Ministry of Transport must equip emergency stations and vehicles with the communications equipment essential for operation.

The Ministry of Health of the republic must give increased attention to the selection, placement and training of skilled personnel as one of the decisive factors involved in improving the level of organization and the quality of work of medical establishments. More exacting requirements and a sense of principle must enter into the resolution of personnel problems. The practice of selecting supervisory personnel on the basis of patronage, blood relationship, personal loyalty and other subjective indications must be decisively eradicated.

Serious attention must be focussed on the creation of a first-rate reserve of personnel for promotion into administrative positions and on improvement in the quality of teaching staffs and scientific personnel. The conditions necessary for improvement of professional qualifications of doctors and medium-trained medical personnel and for in-service training must be created. The practice of sending doctors who show especially good promise to work in centers where they can specialize and to national institutes of scientific research should be widened.

The quality of preparation of doctors in the Azerbaijan State Medical Institute imeni N. Narimanov must be improved. In this connection, the network of clinical bases of the institute must be expanded and strengthened, foreseeing their location in the best research institutes and therapeutic-prophylactic establishments of the republic. Planning for the preparation and utilization of young specialist-physicians and medium-trained medical personnel must be improved.

A resolute struggle must be carried on for the complete eradication of incidents in which medical ethics, socialist law, and the norms and principles of communist morality are breached by medical workers. The work must be strengthened through the ideological, political and moral education of doctors and every medical worker. The creation of a healthy moral and psychological climate in the collective of every therapeutic-prophylactic establishment must be fostered.

The Ministry of Health of the republic is obligated to put into execution effective measures for the further development of medical science and improvement of the activity of institutes and departments of scientific

research. A higher level of performance must be expected from research personnel in carrying out scientific research of contemporary importance. The exacting requirements of practical public health care must be taken into account by these researchers and the positive results of the work of the medical researchers must be promptly introduced into therapeutic practice. The conditions necessary for the further development of science must be ensured, and the volume of complex scientific research done in conjunction with leading medical research centers of the country must be increased.

The Ministry of Health of the republic is expected to provide for the further development and consolidation of the material and technical resources of public health care. It must be continuously occupied with problems of capital construction. It must strengthen the concentration of resources at units being initiated and ensure construction with high-quality project-estimate documentation, financing and equipment. Putting unfinished units into operation with construction abnormalities and defects must not be permitted.

The board and leadership of the Ministry of Health of the republic must constantly and purposefully concern themselves with the problems related to improving the work style and methods of administration of the ministry. They must improve the quality of their supervision over agencies under their jurisdiction. They must develop in every administrative worker a high degree of discipline in performance, responsibility for the work entrusted to him, the ability to critically evaluate the results of his own work, and to show a sense of principle in the battle against shortcomings and negative factors.

The Minpromstroy, Minsel'stroy, Glavbakstroy and Glavazmontazhspetstroy are obligated to ensure the unconditional fulfillment of plans of capital construction of public health care units, to observe strictly the dates fixed for putting them into operation, and to guarantee the high quality of construction work. The Ministry of Light Industry, the Ministry of Local Industry, and the Ministry of the Timber and Wood Processing Industry of the republic are entrusted, when so requested by the Ministry of Health, with ensuring the manufacture of soft goods for the needs of the therapeutic establishments in accordance with models agreed upon, and organizing the output of hospital beds. They must decide which furniture factory or workshop is to specialize in the production of hospital furniture.

The obkom's, gorkom's and raykom's, and the ispolkom's of the Councils of People's Deputies are obliged to give more attention to the work of the establishments of the public health service; to expect a higher level of performance from the leaders of these establishments in supplying good work organization; to improve the quality of medical care rendered to the public; and to eradicate instances of a careless attitude on the part of workers towards carrying out their medical duties and the use of their position for personal gain.

The party, union and Komsomol organizations in the various establishments of the Ministry of Health must increase their involvement in political-education work in medical-establishment collectives. They must form lofty

moral and political qualities in the workers, a sense of principle, and awareness of personal responsibility for the state of public medical services. These groups must carry on a resolute struggle against negative factors, especially cases of extortion, bribery and other abuses.

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SOME QUESTIONS ON THE MORBIDITY OF POULTRY FARMERS

Moscow ZDRAVOOKHRANENIYE ROSSIYSKOY FEDERATSII in Russian No 5, 1979 pp 10-12

[Article by N. A. Glantsberg, A. A. Rozanov, and B. M. Morozov, Zagorsk Central Rayon Hospital, submitted for publication 28 Mar 1978]

[Text] This article presents the results of a study on morbidity with temporary disability of workers in the Zagorsk poultry plant. Morbidity was studied according to the hospital lists and personal accounting cards. For clearness of the analysis results certain forms of pathology were united into groups of diseases according to the principle of their etiogenetic similarity, or according to classes of the international statistical classification. Thus, angina, influenza, and acute respiratory infections were included in the group of "catarrhal diseases"; hypertension, cardiac ischemia and rheumatism--in the group "diseases of the circulatory organs"; acute pneumonia and chronic nonspecific pulmonary diseases--"pulmonary disease." Diseases of the digestive organs, sense organs, female diseases and all types of traumatism were also grouped.

The morbidity with temporary disability per 100 workers is 123.8 cases and 1142.7 days. Allowances for temporary disability were given to 65.1% of the plant workers. Among all the diseases the catarrhal diseases occupy the first place--70.7 and 410.7 per 100 workers (in cases and days) comprising 36.2% of all the disability in days; the other diseases occupy second place--9.5 and 140.5 (12.4% of all the disability) that are single cases of temporary disability for different nosological forms not subject to systematization. All types of traumatism are in the third place--6.2 and 116.4 (10.8% of all labor losses), in the fourth--pulmonary diseases--6.3 and 108.2 (9.8%), and in the fifth--diseases of the nerves and peripheral ganglia--7.4 and 75.5 (6.6%).

The study of morbidity over 3 years (1974-1976) noted a tendency for its increase: in 1974 all the morbidity was 83.5 cases and 717.5 days of temporary disability; in 1975--94.6 and 839.0; and in 1976--123.8 and 1142.7.

Analysis of the nosological structure of the pathology with respect to years made it possible to isolate several groups of diseases whose growth rates were especially high. These forms of pathology also mainly governed the increase in morbidity of workers in the poultry plant in 1976 as compared to 1974. This refers first of all to the eye morbidity: whereas in 1974 it was 0.6 cases and 6.9 days per 100 workers, in 1976--3.7 and 52.9 respectively. There was a more than triple increase in the morbidity in the group of chronic nonspecific pulmonary diseases: in 1974--1.1 cases and 15.2 days; in 1976--3.8 and 72.0. Such a steady growth in the chronic nonspecific pulmonary pathology at the poultry plant was not unexpected.

Under production conditions of the poultry plant the dispersed dust that increases the frequency of morbidity of the respiratory and visual organs has a negative effect. It is also possible that the trend towards an increase in the temporary disability of the poultry farmers because of chronic nonspecific pulmonary diseases is in accordance with the known fact of the steady growth in morbidity of the population from chronic diseases of the respiratory organs.

However it is impossible not to consider the other side to the problem. In 1965 Reed et al. (cited in Warren and Tse, 1974) for the first time described pulmonary diseases in workers of poultry farms with a unique clinical-morphological pattern. The current idea about this disease is reduced to the development of a specific alveolitis that is based on the sensitization of the organism under the influence of the foreign "poultry" antigen contained in the down, feathers and droppings of the poultry. Diverse manifestations of this pathology are contained in the clinical pattern of chronic interstitial pulmonary fibrosis. Certain works of hygienists have proven the ability of dust in the incubator shops to alter the allergic reactivity of the organism (Razdobud'ko, M. A., Lapina, D. M., 1974). In all patients with chronic nonspecific disease of the lungs a diffuse variant of the disease occurs whereby the asthmoid syndrome is manifest in the majority.

From the other classes of diseases that displayed a high level of increase in morbidity one should isolate acute respiratory infections and influenza that increased in frequency by 70% (from 39.5 cases and 204.5 days in 1974 to 64.6 and 375.5 in 1976), infections of the skin and subcutaneous fat--by 80% (from 2.6 and 17.5 to 4.4 and 34.1), hypertension--by 70% (from 3.3 and 34.1 to 5.2 and 59.3). It should be noted here that the morbidity of the cardiovascular system of poultry farmers has its peculiarities: low specific weight of rheumatism and chronic cardiac ischemia (0.1 and 0.9 cases per 100 workers respectively) and greater frequency of hypertension (5.2).

Analysis of the indices of temporary disability depending on sex revealed that the overall morbidity is distributed roughly equally: 61.8% among the men and 67.6% among the women. Only a clear increase in work losses was traced among the men in the group of infectious diseases of the skin and subcutaneous fat (4.9 cases and 4.6 days per 100 workers among the men, and 2.3 cases and 1.4 days among the women), for traumatism (6.1 cases for the men and 3.8 for the women), and in the group of other diseases (8.1 cases and 14.6 days for the men, 6.4 and 7.2 for the women).

It is necessary to note that the level of morbidity is the highest in age to 20 (172.1 cases per 100 workers). In the age group 21-30 this index was 105.4 per 100 workers. Further there is an increase in the number of diseases with the age, and in the age group over 60 it reaches 135.5. The nosological structure of disability is also altered. The catarrhal diseases dominate over the others in all age groups. However, the highest level is manifest in the age group up to 20 (128.4 cases per 100 insured, while in the 51-60 age group--only 72.2). In this same age group there are also high indices of traumatism--14.3 cases, as well as diseases of the female genitalia--14.2. Hypertension is noted more often in the elderly: up to age 20 it is not recorded, 21-30--0.4 cases per 100 workers, 31-40 3.2; 41-50--9.5; 51-60--24.8. Such an increase in morbidity with age was also noted for the class "diseases of the nervous system and sense organs": up to age 20 they were not encountered, 21-30--2.4 cases per 100 workers, 31-40--8.9, 41-50--9.4, 51-60--12.5, and over 60--19.5. The highest pulmonary pathology occurred among individuals in the 41-50 age group (8.8 cases per 100 workers). These diseases were not recorded in individuals under 20.

A study of the morbidity for the main and auxiliary shops of production showed that the greatest losses in capacity for work in the main production cycle (incubation shop--raising shop--parental flock--shop of cage laying hens with egg warehouse--fattening shop--slaughtering shop) are noted in the incubation shop (155.6 cases per 100 workers), the lowest--in the shop of the mother flock (82.3 cases). Among the workers of the shop of cage laying hens 148.1 cases were recorded of diseases per 100 workers, in the shop of raising--120.9, in the feed shop--134.6, and at the egg warehouse--140.1. Among the auxiliary productions the greatest morbidity was noted at the dairy farm (165.9 cases). In the other auxiliary shops the total work losses fluctuated from 111.0 cases to 146.4. Catarrhal diseases dominated. Of the shops of the main production the highest catarrhal morbidity occurred in the incubation shop (100.1 cases), and the lowest--among individuals servicing the mother flock (47.0). There is no doubt that the unfavorable production conditions in the main shops (high temperature and humidity of the air medium, great gas and dust content of the atmosphere) were the decisive factors in the increased morbidity of the respiratory organs as compared to the auxiliary production.

The findings served as the foundation for the formulation of a recommendation to reduce the morbidity with temporary disability of workers in the poultry plant. The set of organizational-preventive measures was directed towards sanitizing the working conditions (improving the ventilation in the rooms, setting up heat screens at the exit from the service rooms, noise control, mechanization of manual operations) and towards increasing the resistance of the organism of the poultry farmers to the harmful production factors (organization of a permeable photarium and inhaler room, introduction of production gymnastics, and methods of seasonal anti-influenza prevention). The further study of the state of health of the poultry farmers dictates the need for conducting special medical examinations using techniques of

allergological diagnostics in order to reveal and subsequently treat specific affections of the respiratory organs. It is also expedient to make detailed hygienic studies of the environment in order to identify and test the allergic damaging agents.

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## PUBLIC HEALTH

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### ALL-UNION CONFERENCE ON RURAL PUBLIC HEALTH

Moscow ZDRAVOOKHRANENIYE ROSSIYSKOY FEDERATSII in Russian No 5, 1979 pp 45-48

[Article by Candidate of Medical Sciences V. P. Bokin]

[Text] The conference took place from 12 through 14 December 1978 in Suzdal'. It was organized by the USSR Ministry of Public Health, AUCCTU, and central committee of the trade unions of medical workers and agricultural workers. Over 350 representatives of all the union republics participated in the work of the conference. Over 30 reports were heard and discussed in the course of 3 days.

The first deputy chairman of the Vladimir oblispolkom of the Soviet of People's Deputies A. G. Anikin addressed the participants of the conference with the welcoming speech.

The main report from the USSR Ministry of Public Health that covered measures for the further improvement in medical assistance to the rural residents in light of fulfillment of the tasks defined by the July (1978) Plenum of the CPSU Central Committee "On the Further Development of USSR Agriculture" was given by the first deputy minister of public health of the USSR S. P. Burenkov. The report analyzed the current state of rural public health, demonstrated the chief outlooks for its further development, the possibilities for bring the levels of medical assistance to the rural and municipal residents closer, and defined the measures for a further perfection in the medical assistance to the rural population.

Rural public health, the speaker noted, has reached in its development, especially after the March (1965) Plenum of the CPSU Central Committee that formulated the modern agrarian policy, a qualitatively new level. Important measures have been taken to develop a network and strengthen the material and technical base of the public health institutions that render preventive-medical, medicinal and sanitary-anti-epidemic assistance to the rural residents. The average capacity of the central rayon hospitals (TsRB) located in the municipal settlements has reached 246 beds, and in the rural settlements--152 beds. The number of independent outpatient clinics has doubled in the last 12 years, while the stations of first aid and emergency medical assistance have increased 1.7-fold. Recently over

10,000 ambulances have been allocated annually for the needs of rural public health. The number of physicians provided for the rural residents in calculation per 10,000 people (with regard for the physicians working in the municipal institutions and helping the rural residents) has been increased 1.6-fold as compared to 1965. The number of hospital beds (with regard for the beds occupied by rural residents in the municipal hospitals) in calculation per 10,000 people has risen 1.4-fold; in the RSFSR it has increased from 78.6 in 1965 to 119.0 in 1977. The level of hospitalization of the rural residents in calculation per 100 people rose to 23.1 in 1977 and exceeded the analogous index for the rural population. The number of medical outpatient-polyclinic visits per one rural resident has risen in the last 12 years 1.6-fold.

S. P. Burenkov focused a lot of attention on questions of developing the network and strengthening the material and technical base of rural public health institutions. As the speaker noted the focus of attention must be questions of improving the efficient use of the material and technical base of the active rural public health institutions, and most of all the sectional, rayon hospitals and TsRB, since 1.101 million beds have opened up in them, and this is almost 1/3 of all the beds in the country. Therefore it is important to improve the continuity in operation of the outpatient-polyclinic and hospital institutions, to take measures to improve the quality and increase the volume of the prehospital examination of the patients, expand the use in the rural outpatient-polyclinic institutions of the methods for recovery treatment, as well as successfully solve the questions of specializing the bed fund in the sectional, rayon hospitals and TsRB, and develop the inter-rayon large specialized departments.

The speaker further indicated that a higher level of organization of the sanitary-epidemiological service's work must correspond to the new stage of accelerated intensification of agriculture. It is necessary to intensify the state sanitary inspection over the observance in this most important branch of the national economy of the sanitary-hygienic and sanitary-anti-epidemic norms and regulations. Environmental protection acquires especial importance in the rural locality. It is necessary to intensify the preventive work among the rural population to prevent diseases, further reduce the occupational morbidity and production traumatism, and increase the efficiency of the clinic observation of machine operators and workers on animal husbandry farms.

Medical science has been called upon to play an important role in solving the tasks facing rural public health. It remains to expand research in the area of organizing medical assistance to the rural population, industrial hygiene of occupational diseases, medical aspects of environmental protection in the rural locality, as well as protecting the health of women and children; the achievements of medical science, the progressive forms and methods of work, leading experience and scientific organization of the labor of medical workers should be more persistently introduced into the practice of the rural medical institutions.

S. P. Burenkov also dwelt on questions of using new staff standards for the medical, pharmaceutical personnel and the kitchen workers of the TsRR, of the municipal (in cities with population to 25,000 people) hospitals and polyclinics (outpatient clinics), sectional hospitals, outpatient clinics in the rural locality and paramedic-obstetric points approved by the order of the USSR Ministry of Public Health of 26 October 1978. The introduction of new standards will promote an improvement in the medical assistance to the rural residents.

The secretary of the central committee of the medical workers' trade union S. M. Kulagin spoke about the tasks of the medical workers' trade union that follow from the decisions of the July (1978) Plenum of the CPSU Central Committee. The central committee of the medical workers' trade union jointly with the USSR Ministry of Public Health and the branch committees of trade unions have worked out a plan of measures directed towards the further perfection of medical and sanitary services for the toilers of the village. An important reserve, S. M. Kulagin stressed, is contained in strengthening the health of the medical workers themselves; there are serious shortcomings in the organization by them of medical assistance and clinical observation. This question requires the most intent attention on the part of the organs of public health and the trade union committee. The speaker noted that the educational and cultural-mass work of many trade union organizations of the rural institutions of public health should be activated so that it meets the modern requirements.

The deputy minister of public health of the RSFSR N. T. Trubilin related the organization and outlook for a further improvement in rendering medical assistance to the rural residents of the republic. Especial attention is being concentrated on improving the medical servicing of the toilers in the village of the RSFSR nonchernozem zone. The problems of developing public health in this zone must be solved jointly with the RSFSR Ministry of Agriculture, the central committee of medical workers' trade union, and the republic committee of the trade union of agricultural workers. Such a form of work will make it possible to obtain a number of advantages and will yield positive results. It is now being employed in the majority of oblasts, krais, and autonomous republics of the Russian Federation.

Efficiency promotion for the use of the bed fund, introduction of effective methods of diagnostics and treatment, improvement in the organization of labor of the medical personnel in 1977 alone yielded an economic effect expressed in the sum of 450,000 R. In speaking of the development of specialized medical assistance and bringing it to the rural residents the speaker expressed the opinion that it is necessary to formulate conclusions on the interoblast specialized centers, as well as the staffs of the inter-rayon specialized departments. In the republic experience has been accumulated on organizing kolkhoz-sovkhoz dispensaries for machine operators and stock breeders that should be generalized.

The secretary of the central committee of the agricultural workers' trade union, A. I. Popov, spoke about the tasks of the trade union organizations to further sanitize the toilers of agriculture. Many unsolved questions of protecting the health of rural workers can be solved only by the joint efforts of the trade union organizations, agricultural organs, and medical workers.

Speaking about the further improvement in preventive medical aid to the rural population, the head of the main administration of preventive medical aid of the Ukrainian SSR Ministry of Public Health V. M. Kozlyuk stressed that currently the republic has at its disposal considerable material and personnel resources that make it possible to more intensively and efficiently solve the tasks in the area of rural public health.

The first deputy minister of public health of the Kazakh SSR, N. M. Gribov, reported on the state and outlook for bringing specialized medical aid closer to the rural residents. Major measures have been planned in the republic to develop the network and strengthen the material and technical base of the rural public health institutions. In particular, in the 11th Five-Year Plan a 11,000 bed TsRB will be built and outpatient-polyclinic institutions almost for 17,000 visits per shift; it is planned to construct a republic clinic hospital for 1000 beds; 350 stomatological and 40 dental-prosthetic offices (departments) will be opened in the rural locality. The development of mobile medical aid stations is of especial importance for the Kazakh SSR.

The report of the deputy minister of public health of the Belorussian SSR L. P. Marinkevich covered in detail the experience of realizing the active legislature on presenting privileges to the rural residents of the republic. The head of the administration of preventive medical aid of the Lithuanian SSR Ministry of Public Health, B. A. Grinbergene told about the state of the outpatient-polyclinic assistance in the village and its further bringing closer to the rural residents of the republic. The rural medical outpatient clinics are built from budget resources, and cooperative resources of the kolkhozes. Before 1985 it is planned to construct 67 such institutions, including 46--from cooperative resources. The deputy minister of public health of the Armenian SSR L. N. Muradyan stressed that at the current stage in the republic great importance is attached to strengthening the TsRB, reorganization of the small sectional hospitals, development of medical outpatient clinics, creation of large hospitals and specialized departments that fulfill the functions of inter-rayon.

The head of the main sanitary-epidemiological administration of the USSR Ministry of Public Health, V. Ye. Kovshilo dwelt in detail on the questions of guaranteeing industrial hygiene in agricultural production. The problems of a scientifically substantiated approach to constructing a network of preventive medical institutions, rendering aid to the rural residents, and questions of controlling public health in the rayon were examined in the reports of the colleagues of the N. A. Semashko All-Union Scientific Research Institute of Social Hygiene and Organization of Public Health M. I. Gavrilov and E. R. Agayev.

The head of the Vladimir oblast public health section B. M. Trukhnov spoke of the state and outlook for improvement in the medical aid to rural residents. In the oblast a long-term plan has been formulated for the development of public health for 1978-1985 in which especial attention is concentrated on measures to develop a network of outpatient-polyclinic institutions in the village, and organize inter-rayon specialized centers, departments, and offices. The paths towards a further improvement in outpatient-polyclinic assistance to the rural population of the Ivano-Frankovskaya oblast were covered by the head of the oblast public health section V. S. Stukal. He noted that cooperative resources of the sovkhozes and kolkhozes are being widely drawn upon for construction of medical institutions.

A pithy speech was given by the assistant chief physician of the Gor'kov oblast hospital Yu. N. Ivanchenko who shared the experience of organizing emergency and consultative assistance to the rural population. The speaker cited convincing figures characterizing the high effectiveness of this work.

The participants of the conference listened with great interest to the report of the chief physician of the Valmiyera TsRB of the Latvian SSR U. V. Lautsis. He related how with the help of the party and soviet organs, trade union organizations in the rayon the problems were solved for the development and strengthening of the material and technical base of the public health institutions, as well as how the leadership and collective of the TsRB guarantee the introduction of modern methods of examination, diagnostics, treatment and prevention of diseases, scientific organization of labor, and bringing specialized aid closer to the rural residents. The speech was illustrated with a movie. The experience of organizing medical aid to women living in the rural regions of the Moskovskaya oblast was shared by the deputy head of the main administration of public health of the Mosoblispolkom [Executive Committee of the Moscow Oblast Soviet of Workers' Deputies] N. A. Savenkova.

The experience of joint work of the committees of trade unions, medical workers and agricultural workers to improve the health protection of the rural toilers was related by the chairman of the Mogilevskaya oblast committee of the agricultural workers' trade union R. K. Shcherbinskaya, secretary of the Permskaya oblast council of trade unions V. P. Burov, and the chairman of the Stavropol'skiy kray committee of medical workers' trade unions V. P. Romantsev, and others.

The discussion participants included the public physician of the USSR, obstetrician-gynecologist of the rayon hospital of the Kazakh SSR Z. M. Madiyeva, Hero of Socialist Labor, chief physician of the sectional hospital of the Kirovogradskaya oblast V. I. Boroznyak, assistant chief physician of the Mogilevskaya oblast hospital A. K. Shareyko, chief physician of the Tyumenskaya oblast hospital V. V. Shevchuk, head of the Astrakhanskaya oblast public health department A. M. Nichoga, chief

physician of the Voronezhskaya oblast clinical hospital L. V. Yadykina, chief physician of the Volgogradskaya oblast clinical hospital V. D. Koro-beynikov, deputy head of the Tomskaya oblast public health department V. F. Oleynichenko, and others.

The first deputy minister of public health of the USSR S. P. Burenkov summarized the conference; he answered numerous questions and expressed confidence that the medical workers will guarantee a further increase in the quality and level of medical assistance to the rural residents, and at the same time will make a worthy contribution to the fulfillment of the tasks defined by the historical decisions of the 25th CPSU Congress, the July (1978) and November (1978) Plenums of the CPSU Central Committee.

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